Enilit RTU

User manual

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Content

Content 2
1. Introduction 6
1.1 User manual 6
1.2 Enilit RTU 6
2. Safety 8
2.1 Introduction 8
2.2 Health and safety 8
2.2.1 Service and Maintenance 8
2.2.2 Electrical Connections 9
2.2.3 Earthing 9
2.2.4 Power Supply Connection 9
2.2.5 Terminals 10
2.2.6 Data Transmission Cables 10
2.3 Decommissioning and disposal 10
2.3.1 Decommissioning 10
2.3.2 Disposal 10
2.4 Declaration of conformity 10
2.5 Handling of electronic equipment 11
2.6 Warnings regarding use of UAB Enilit products 12
2.7 Guarantees 12
2.8 Copyright 13
3. Enilit RTU Hardware 14
3.1 System Conception 14
3.2 Rack mounting and Frame 15
3.2.1 Basic frame 15
3.2.2 Second frame 16
3.3 Short hardware review 16
3.3.1 Power Supply Module 17
3.3.2 Central Processor Modules 17
3.3.3 I/O Modules 17
3.4 Additional features 18
3.5 Central processor unit module CPU 19
3.5.1 Serial communication interface (RJ-45) 22

3.5.2 Ethernet interface (RJ-45) 23
3.5.3 Technical Data 24
3.5.4 WatchDog 24
3.6 Power Supply Module 25
3.6.1 Wiring diagram 26
3.6.2 Technical Data 27
3.7 Digital Input Module 28
3.7.1 Wiring diagram 29
3.7.2 Technical Data 30
3.8 Digital Output Module 31
3.8.1 Wiring diagram 32
3.8.2 Technical Data 33
3.9 Analogue Input Module AI-31 34
3.9.1 Wiring diagram 36
3.9.2 Technical Data 37
3.10 Fiber optic module ST-61 38
3.11 Installation of System Housing 38
3.12 Order-book 39
3.12.1 Basic frame 39
3.12.2 Second frame 42
4. Enilit RTU software 43
4.1 Introduction 43
4.2 System capabilities 43
4.3 Licensing 43
4.4 User interface 45
4.5 Configurator 50
4.5.1 User groups 51
4.5.2 Create user groups 51
4.5.3 Create user with rights 52
4.6 Users authentication 56
4.7 Project manager 57
4.7.1 Basic information 57
4.7.2 Import project 60
4.7.3 Export project 60
4.8 Main configuration 61

4.8.1 IP addresses 61
4.8.2 Remote management 63
4.9 Hardware configuration 68
4.9.1 Power supply 69
4.9.2 CPU 69
4.9.3 Card Slots 70
4.9.4 Hardware items parameters 72
4.9.5 Hardware Tags 75
4.10 Master protocols 90
4.10.1 IEC 60870-5-103 configuration 90
4.10.2 IEC 60870-5-101 configuration 102
4.10.3 IEC 60870-5-104 configuration 114
4.10.4 IEC 61850 client 123
4.10.5 Modbus RTU/ASCII 131
4.10.6 Modbus TCP client 137
4.10.7 DNP3 serial master configuration 139
4.10.8 DNP3 UDP/TCP/IP client configuration 141
4.10.9 Simulator master configuration 143
4.10.10 RP-570 configuration 146
4.11 Slave protocols 148
4.11.1 IEC 60870-5-101 protocol configuration 148
4.11.2 IEC 60870-5-104 protocol configuration 158
4.11.3 DNP3 serial slave configuration 167
4.11.4 DNP3 UDP/TCP/IP server configuration 169
4.12 Tag manager 172
4.12.1 Tag states 176
4.13 Internal programmable logic 179
4.14 Programmable logic *IsaGRAF* 182
4.14.1 IsaGraf function blocks 184
4.14.2 IsaGraf data types 192
4.15 Time management 194
4.15.1 SNTP client 194
4.16 Self-control and diagnosis 198
4.16.1 Hardware monitoring 198
4.16.2 Protocol monitoring 200

4.16.3 System log 204
4.16.4 Events log 204
4.17 Redundancy 207
4.17.1 Redundancy support 207
4.17.2 Redundancy types 207
4.17.3 Connection diagram 207
4.17.4 Enilit RTU redundancy principles 208
4.17.5 Monitored fault locations 209
4.17.6 Communication channel configuration 209
4.17.7 Status signals, commands and measurements 211
4.18 Cyber security capabilities 213
4.18.1 Introduction 213
4.18.2 Electronic access control 213
4.18.3 Audit trail 215
4.18.4 Supervisory monitoring and control 217
4.18.5 Configuration software 217
Abbreviations 219
Contacts 220

1. Introduction

1.1 User manual

This document is a helpful resource for utility customers or Enilit partners who are purchasing or evaluating Enilit RTU (remote terminal unit). It is intended for readers who have knowledge of substation automation equipment and applications.

This document provides a technical overview of the Enilit RTU.

The document is organized as follows:

1. Content: This section provides a content of this document.
2. Introduction: This section provides short overview of this document and main Enilit RTU functions and possible applications.
3. Safety: This section provides safety of working with Enilit RTU system.
4. Hardware: This section provides an overview of the Enilit RTU hardware.
5. Software: This section provides an overview of the Enilit RTU software.

Note. User manual for this device gives instructions for its installation, commissioning, and operation. However, the user manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact UAB Enilit office and request the necessary information.

1.2 Enilit RTU

The automation technology is rapidly advancing. New communication techniques and devices and standard protocol interfaces combined with the immense computing power of today's hardware components open the way to new concepts in automation. At the same time, the growing demands of utility owners for more cost-effective control systems must be met.

Enilit RTU is our solution for automation applications. The modular and open structure of the Enilit RTU system sets wide range where it could be used:

- Electric power generation plants;
- Electricity transmission and distribution networks;
- Traffic control systems (railways; metro, tramways and etc.)
- Supply networks of municipal and regional public utilities (gas, electricity, water, sewage, district heating and etc.);
- Data acquisition and control in buildings systems (escalators, lighting, air conditioning and etc.);
- Monitoring and control of chemical and petrochemical plants and pipelines;

- Environmental technology with measured data acquisition and remote evaluation.

Main tasks what the Enilit RTU is doing:

- Control and monitoring of a system from a control center via reliable remote data transmission protocols,
- Multitude of communication possibilities via various transmission media (LAN, radio relay system and etc.),
- Fast time-sequential processing of digital and analogue process data with high resolution time marking (1 millisecond),
- Secure process inputs / outputs with high isolation voltage (2,5 kV),
- Pre-processing and compressing of acquired process data (e.g. metered value formation, threshold value processing, initiation delay, debouncing, signal damping),
- Optimized flow of remote data transmission (spontaneous, cyclic or on-demand transmission, differentiated interrogation lists, priority improvement, general interrogation, selective message repeat command),
- Time-saving, user-optimized parameterization with minimum effort Enilit RTU Configuration and management software (CMS) with Microsoft Windows operating system,
- Open interfaces which permit connection of peripheral units (e.g. printer or operator panel).

2. Safety

2.1 Introduction

This documentation includes information for qualified technical personnel. It describes the safety, handling, packing and unpacking procedures applicable to Enilit RTU hardware and software tools.

2.2 Health and safety

THIS SAFETY SECTION SHOULD BE READ BEFORE COMMENCING ANY WORK ON THE EQUIPMENT.

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

To preclude the possibility of personal danger, the following safety requirements must be fulfilled at any time:

1. The operating voltage specified in technical documentation must never be exceeded.
2. Always disconnect the device before changing the system or signaling wiring.
3. The housing does not contain any operation-relevant elements. The device must never be opened.
4. Do not operate the device in inflammable or explosive environments.
5. Do not expose the device to rain or humidity.
6. With regard to the installation location, take care that the ventilation is sufficient to make sure that the permissible operating temperature is not exceeded.
7. For wiring, please make sure that you use only cables that are able to withstand temperatures of at least 85 ºC.
8. Please ensure that not isolated line ends are not exposed in order to minimize the danger of electric shocks or short circuits.

2.2.1 Service and Maintenance

The device should be installed in a dry, clean environment. To ensure its proper functioning, it is necessary to make sure that the specified ambient conditions are fulfilled.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electrical shock or energy hazards.

It is not necessary to clean the device after installation. But if it is needed to cleaning, please switch off the device and wipe it off with a soft, clean and dry piece of cloth. Do not use any detergents for cleaning.

2.2.2 Electrical Connections

Connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated the correct crimp terminal and tool for the wire size should be used.

2.2.3 Earthing

Before energizing the equipment it must be earthed using the protective earth terminal, or the appropriate termination of the supply plug in the case of plug connected equipment.
Omitting or disconnecting the equipment earth may cause a safety hazard.
Recommended minimum earth wire size is 2.5mm².

2.2.4 Power Supply Connection

This device does not have its own mains switch and starts operation immediately after the application of system voltage. Hence, a switch must be included in the wiring scheme which must be labelled appropriately and which must be installed in the vicinity of the device and within the operator's reach. The switch has to fulfill the requirements acc. to standards IEC 947-1 and IEC 947-3.
The recommended maximum rating of the external protective fuse for this equipment is:

Supply voltage	Fuse, A
110VDC	6
220VDC	4
115VAC	6
230VAC	4

For the supply of the feeder voltage please use cables with the 1.5 mm² cross section.

2.2.5 Terminals

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.
Clamping range:

Terminals	Wire, mm^2
Power supply	0.5 ... 2.5
Process connection	0.2 ...2.5
Data communications	0.2 ...2.5

2.2.6 Data Transmission Cables

For data transmission, telecommunications cables with twisted-pair double-core cables with braided shielding (effective core diameter: 0.6/0.8 mm2, optical cover of the screen > 80 %) acc. to VDE0815/ VDE0816 shall be used. The cable shield has to be laid planar on a bonding jumper/earth circuit connector (central earthing point).

2.3 Decommissioning and disposal

2.3.1 Decommissioning

The auxiliary supply circuit in the Enilit RTU may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the Enilit RTU (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to decommissioning.

2.3.2 Disposal

It is recommended that incineration and disposal to watercourses be avoided. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, in order to avoid short circuits. Particular regulations within the country of operation may apply to the disposal of lithium batteries.

2.4 Declaration of conformity

Device being the subject of this instruction was constructed and prepared and it is manufactured for the purpose of use in industrial environment. At device constructing and manufacturing were complied with such norms which fulfilling is being ensure the realization of specific rules and precautions, provided that

the user obeys the given guidelines of device installing and starting as well as its operation leading. This device is compliance with EU directive resolutions:

Name	Description
2004/108/EC	Electromagnetic Compatibility (EMC) Directive
2006/95/EC	Compliance with the European Commission Low Voltage Directive

Conformity to directives was confirmed by tests performed in independent from manufacturer measurement and research laboratories and develops centers.

Standard consistent with directive 2004/108/EC

Name	Description
EN 55022:2010	Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement (CISPR 22:2008)
EN 55024:2010	Information technology equipment - Immunity characteristics - Limits and methods of measurement (CISPR 24:2010)
EN 61000-3-2:2006 + A1:2009 + A2:2009	Electromagnetic compatibility (EMC) – Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase) (IEC 61000-3-2:2005)

2.5 Handling of electronic equipment

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits of UAB Enilit products are immune to the relevant levels of electrostatic discharge when housed in their cases. Do not expose them to the risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices.

However, if it becomes necessary to withdraw a module, the following precautions should be taken in order to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are a same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.
3. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.

4. Place the module on an antistatic surface, or on a conducting surface, which is at the same potential as you.
5. Store or transport the module in a conductive bag.

If you are making measurements on the internal electronic circuitry of any equipment in service, it is preferable that you are earthen to the case with a conductive wrist strap.

Wrist straps should have a resistance to ground between 500k – 10M Ohms. If a wrist strap is not available you should maintain regular contact with the case to prevent the buildup of static. Instrumentation which may be used for making measurements should be earthen to the case whenever possible.

More information on safe working procedures for all electronic equipment can be found in IEC 60147-0F and BS5783.

2.6 Warnings regarding use of UAB Enilit products

UAB Enilit products are not designed with components and testing for a level of reliability suitable for use in connection with surgical implants or as critical components in any life support systems whose failure to perform can reasonably be expected to cause significant injuries to a human.

In any application, including the above reliability of operation of the software products can be impaired by adverse factors, including - but not limited - to fluctuations in electrical power supply, computer hardware malfunctions, computer operating system, software fitness, fitness of compilers and development software used to develop an application, installation errors, software and hardware compatibility problems, malfunctions or failures of electronic monitoring or control devices, transient failures of electronic systems (hardware and/or software), unanticipated uses or misuses, or errors from the user or applications designer (adverse factors such as these are collectively termed "System failures").

Any application where a system failure would create a risk of harm to property or persons (including the risk of bodily injuries and death) should not be reliant solely upon one form of electronic system due to the risk of system failure to avoid damage, injury or death, the user or application designer must take reasonable steps to protect against system failure, including - but not limited - to back-up or shut-down mechanisms, not because end-user system is customized and differs from UAB Enilit testing platforms but also a user or application designer may use UAB Enilit products in combination with other products.

These actions cannot be evaluated or contemplated by UAB Enilit; Thus, the user or application designer is ultimately responsible for verifying and validating the suitability of UAB Enilit products whenever they are incorporated in a system or application, even without limitation of the appropriate design, process and safety levels of such system or application.

2.7 Guarantees

UAB Enilit guarantees that the information in this document is accurate. The document has been carefully reviewed for technical accuracy. In the event that technical or typographical errors exist, UAB Enilit reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should consult UAB Enilit if errors are suspected. In no event shall UAB Enilit be liable for any damages arising out of or related to this document or the information contained in it.

The media on which you received UAB Enilit software are guaranteed not to fail executing programming instructions, due to defects in materials and workmanship, for a period of 90 days from date of shipment, as evidenced by receipts or other documentation. UAB Enilit will, at its option, repair or replace software media that do not execute programming instructions if UAB Enilit receives notice of such defects during the guaranty period.

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2.8 Copyright

Copyright UAB Enilit all rights reserved.

We reserve the right to claim damages in the event of infringements of the above.

3. Enilit RTU Hardware

3.1 System Conception

Enilit RTU is a modular, freely scalable remote control and automation device.

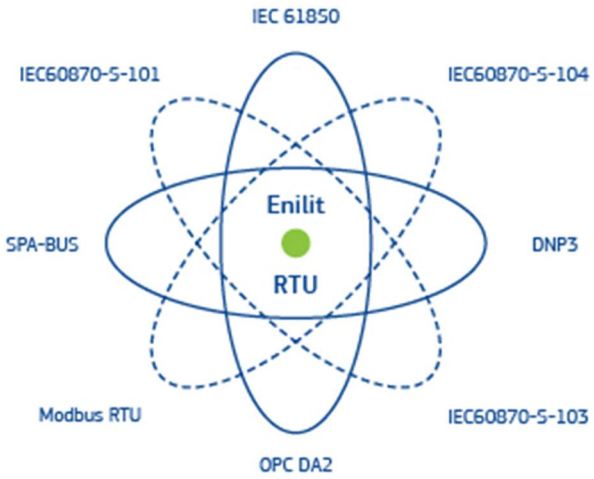
Its field of application is the fully-automatic monitoring and control of decentralized process stations or RTUs (e.g. in medium voltage switches bays). Plug-in I/O modules serve for process connection, and communication modules are available for the additional connection of subsystems (e.g. for serial connection of sensors and actuators).

Communication between the different RTUs and between RTUs and the control center can take place via different media, for instance

- dedicated lines (private or leased lines) based on copper cables or glass FO cables
- dial-up connections via analogue telephone network, digital ISDN network and GSM networks (900 MHz, e.g. D1 or D2)
- serial interfaces V.24/V.28 in combination with transmission systems like PCM30, PDH or SDH systems, or with private radio networks
- LAN/WAN connections via 10/100 MB/s-Ethernet und TCP/IP

It supports the following communication protocols:

- IEC 60870-5-101
- IEC 60870-5-103
- IEC 60870-5-104
- DNP3 serial
- DNP3 TCP/IP
- IEC 61850
- Modbus RTU/ASCII
- Modbus TCP
- RP-570
- OPC DA2



Data transmission - in its standard form - takes place via IEC 60870-5-101 protocol (symmetrical and asymmetrical procedure).

Protection equipment can be connected via IEC 60870-5-103, Modbus RTU, DNP3, IEC 61850 and RP570 protocols.

Network interfaces enable communication via IEC 60870-5-104, DNP3and Modbus TCP protocol.

Automation tasks can be integrated by means of the optional PLC functionality according to IEC 61131-3.

Configuration and management can be carried out either locally via the software or via network from remote computer.

3.2 Rack mounting and Frame

3.2.1 Basic frame

Enilit RTU frame consists of a metal housing, an internal bus system and plug-in system components. A standard RTU includes at least a power supply module and a central processor module. Maximum number of 12 slots for I/O and communication modules is available.

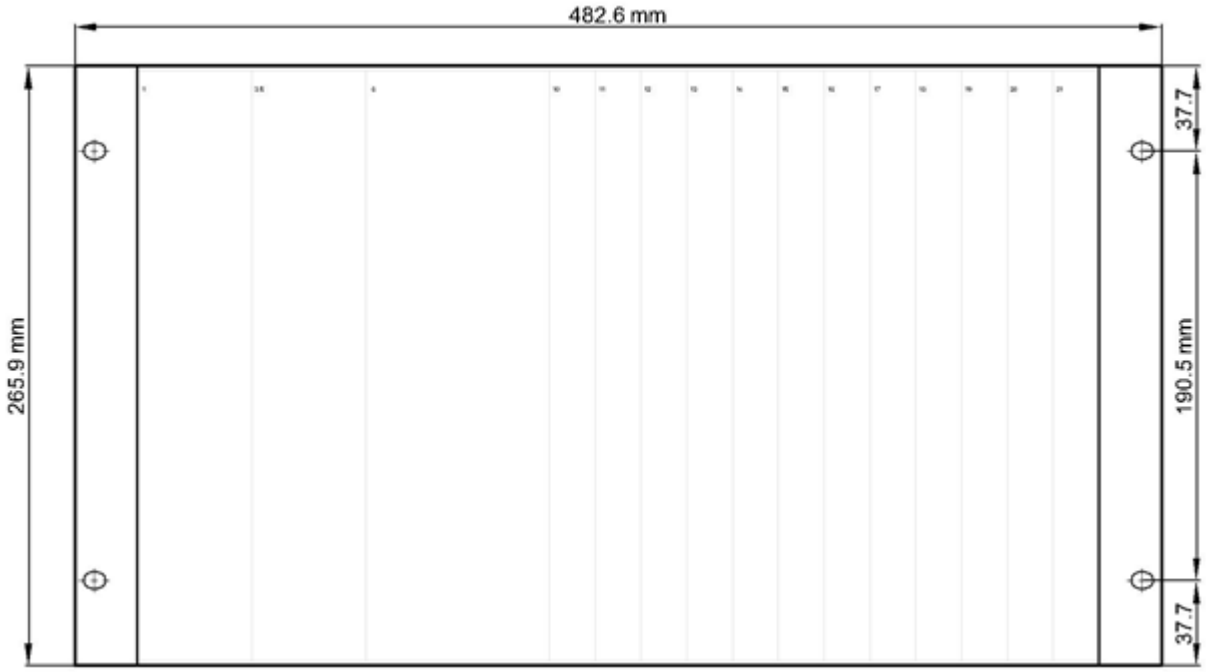


Figure 1. Front view

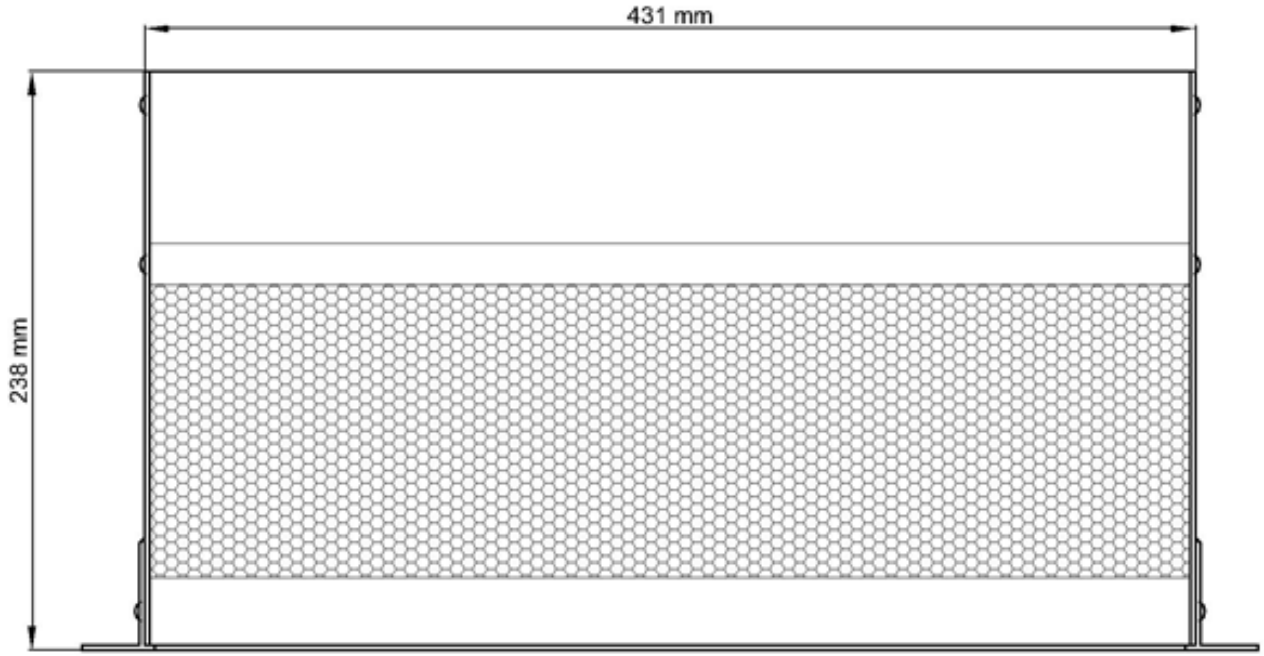


Figure 2. Top view

3.2.2 Second frame

More I/O modules can be achieved by connecting two basic frames. Second frame should have Power Supply and can have 16 I/O or communication modules of any type. Frames are connected with external cable for communication between CPU and modules of the second frame. Expanding Enilit RTU with second frame, you can achieve 28 I/O modules.

3.3 Short hardware review

The remote terminal unit "Enilit RTU" device comes in one basic 6U frame system. One frame can include:

- two power supply modules,
- central processor module (second frame not necessary),
- 12 slots for I/O and communication modules (at maximum 12 boards inside one rack could be installed. Place of the boards according type in the rack it isn't necessary. No difference for RTU what type (DI, DO, AI or ST) board is installed in the slot).

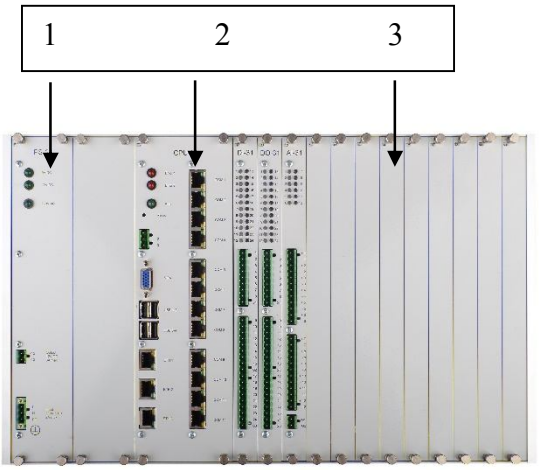


Figure 3. Front view of Enilit RTU

No.	Explanation
1	Power supply module
2	Central processor module
3	I/O modules

3.3.1 Power Supply Module

There is four type of power supply module available:

Application	Module
Input voltage 115V AC	PS-11
Input voltage 230V AC	PS-21
Input voltage 110V DC	PS-31
Input voltage 220V DC	PS-41

3.3.2 Central Processor Modules

The central processor module is in charge of communication interface operation, control of I/O modules, acquisition and archiving of process information and execution of PLC programs.

The following central Processor Modules are available in the standard versions:

Module	Communication interfaces
CPU-3x	3 Ethernet (RJ45), 12 Serial links (RJ45)
CPU-4x	4 Ethernet (RJ45), 12 Serial links (RJ45)

3.3.3 I/O Modules

Depending on the scope of process data, it is possible to fit the free slots with the necessary I/O modules, irrespective of the signal type.

The following I/O modules are available:

Application	Module	I/O	Description
Digital input	DI-11	24	24VDC
Digital input	DI-21	24	60VDC
Digital input	DI-31	24	110VDC
Digital input	DI-41	24	220VDC
Digital output	DO-31	24	DC13, 250 VDC, 0.2A
Analogue input	AI-31	12	-20 mA to +20 mA or -10V to 10 V.
Fiber optic module	ST-61	6	6 x FO (ST type)

3.4 Additional features

External VGA compatible monitor, keyboard and mouse for RTU monitoring, management and configuration.

External Touch Screen monitor for one or several feeders visualization and control (HMI).

Computer with SCADA for local substation management.

Protocol converter (gateway).

3.5 Central processor unit module CPU

There are seven types of central processor unit modules available:

Module	Communication interfaces
CPU-31	3 x Ethernet (RJ45), 12 x RS485 Serial links(RJ45)
CPU-32	3 x Ethernet (RJ45), 4 x RS232 Serial links(RJ45), 8 x RS485 Serial links(RJ45)
CPU-33	3 x Ethernet (RJ45), 8 x RS232 Serial links(RJ45), 4 x RS485 Serial links(RJ45)
CPU-34	3 x Ethernet (RJ45), 12 x RS232 Serial links(RJ45)
CPU-41	4 x Ethernet (RJ45), 12 x RS485 Serial links(RJ45)
CPU-42	4x Ethernet (RJ45), 4 x RS232 Serial links (RJ45), 8 x RS485 Serial links (RJ45)
CPU-43	4x Ethernet (RJ45), 8 x RS232 Serial links (RJ45), 4 x RS485 Serial links (RJ45)
CPU-44	4x Ethernet (RJ45), 12 x RS232 Serial links (RJ45)

The central processor module CPU serves for the operation of the communication interfaces, for control of the I/O modules, for the acquisition and archiving of process information and for the execution of PLC programs.

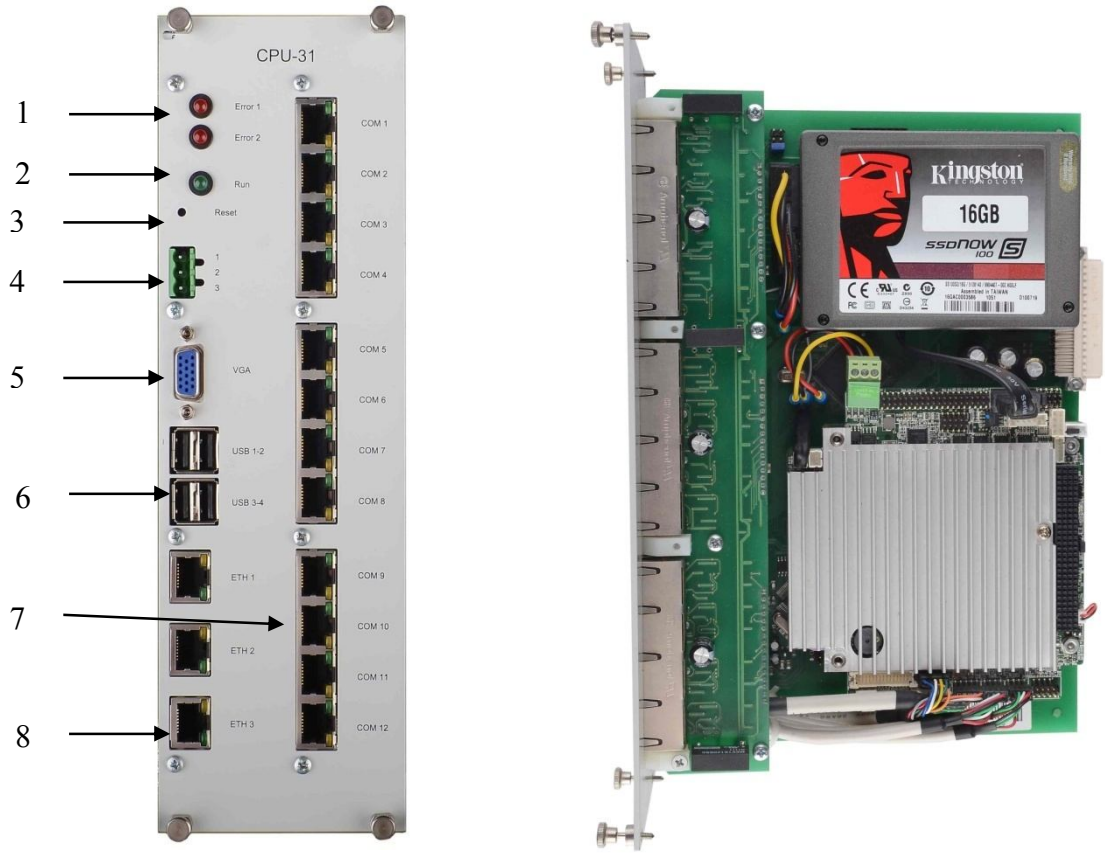


Figure 4. Central processor unit front and side view

No	Explanation	Note	Function	LED indication
1	LED indicator	Error1	Hardware configuration status	LED is BLINKING– mistake in hardware configuration
		Error2	User defined	
2	LED indicator	Run	CPU status	LED is BLINKING - device is OK (running)
3	Push button	Reset	Manually reset device by pushing	
4	Connection terminals		Watchdog	
5	VGA socket	VGA	Socket to connect LCD monitor	

6	USB socket	USB1-USB4	Socket to connect keyboard, mouse, USB stick and etc.
7	Serial communication interface socket RJ-45	COM1-COM12	Connect others RTUs or protection devices
8	Ethernet communication interface socket RJ-45	ETH1-ETH3	Connect control centers or protection devices

Note. If Error1 and Error2 LEDs lights up and RUN LED is OFF, that means CPU error or system is starting.

3.5.1 Serial communication interface (RJ-45)

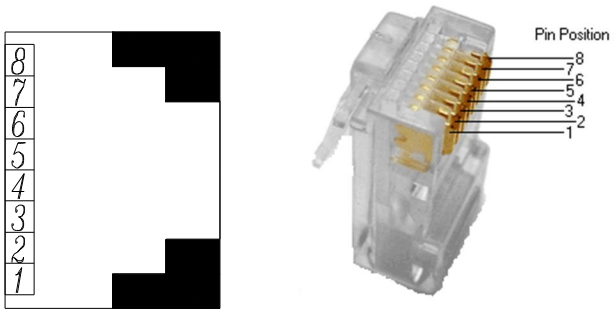
The CPU-3x has 12 serial communication ports.

The CPU-7x has 8 serial communication ports.

The serial communication interfaces (RS232 or RS422/485) is designed as 8-pole RJ45 connector with integrated LEDs.

CPU module RJ-45 (COM) connector pin assignment for RS422/485:

Pin	Designation				
	RS-232	RS-422	RS-485 (4 wire)	RS-485 (2 wire)	
1	Not used	Not used	Not used	Not used	
2	RX	RX +	RB +	DB +	2 - 3 pins should be linked together
3	TX	TX +	TB +	DB +	
4	Not used	GND	GND	GND	
5	GND	RX -	RA -	DA -	5 - 6 pins should be linked together
6	Not used	TX -	TA -	DA -	
7	Not used	Not used	Not used	Not used	
8	Not used	Not used	Not used	Not used	



a) RTU side b) Cableside

Figure 5. RJ45 connector

The status of each communication interface is shown via the two software-controlled LEDs that are installed in the connectors.

The yellow LED lights up if there is a physical connection to a device, i.e. if the connection layer is in operation. The green LED is activated during transmission of data in the transmission or the receive direction.

3.5.2 Ethernet interface (RJ-45)

The Ethernet communication interfaces are designed as 8-pole RJ45 connector with integrated LEDs. Pin assignment:

Pin	Designation
1	-TX
2	+TX
3	+RX
4	Not used
5	Not used
6	-RX
7	Not used
8	Not used

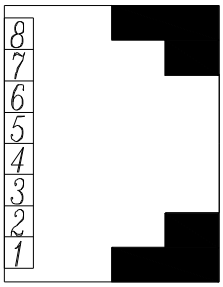


Figure 6. RJ45 connector

The status of each communication interface is shown via the two software-controlled LEDs that are installed in the connectors:

The yellow LED lights up if there is a physical connection to a device, i.e. if the connection layer is in operation. The green LED is activated during transmission of data in the transmission or the receive direction.

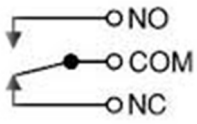
3.5.3 Technical Data

Feature	Value
Processor	64-bit microprocessor – 1.6 - 1.8 GHz; Intel Atom internal watchdog; 1024...2048 MB Dynamic memory DRAM; 16 GB Solid State Drive (for software, databases, events, waveforms, parameters);
Communication interfaces	RS485 / RJ45 socket (8-pin socket); DTE / max. speed: 115,2 Kb;
Ethernet interface	Ethernet (10/100/1000 Base-TX) / RJ45 socket (8-pin socket) Twisted-pair cable CAT5 / speed: 10/100/1000 Mbps
Working temperature	0 ~ +60°C, on request range can be extended
Working humidity	5 ~ 95%, non-condensing

3.5.4 WatchDog

WatchDog State	Description
Normal	Device is turned on, Enilit CMS is working, RTU hardware configuration state has no abnormal card states
Normal	Device is starting, Watchdog relay time out timer didn't end.
Error	Device is turned off
Error	Enilit CMS is closed and Watchdog relay time out timer ended
Error	RTU hardware configuration state has abnormal card states
Error	RTU has detected a hardware error.

Terminal	Function
1	NO
2	COM
3	NC



3.6 Power Supply Module

There is four type of power supply module available:

Application	Module
Input voltage 115V AC	PS-11
Input voltage 230V AC	PS-21
Input voltage 110V DC	PS-31
Input voltage 220V DC	PS-41

Each type off power supplies has 12V DC output which can be used to connect power supply for external monitor or some other device. Max power for this output is 3 Amps.

In one Enilit RTU can be installed two power supply units whose one can work from different voltages: one from AC and another from DC supply voltage at the same time.

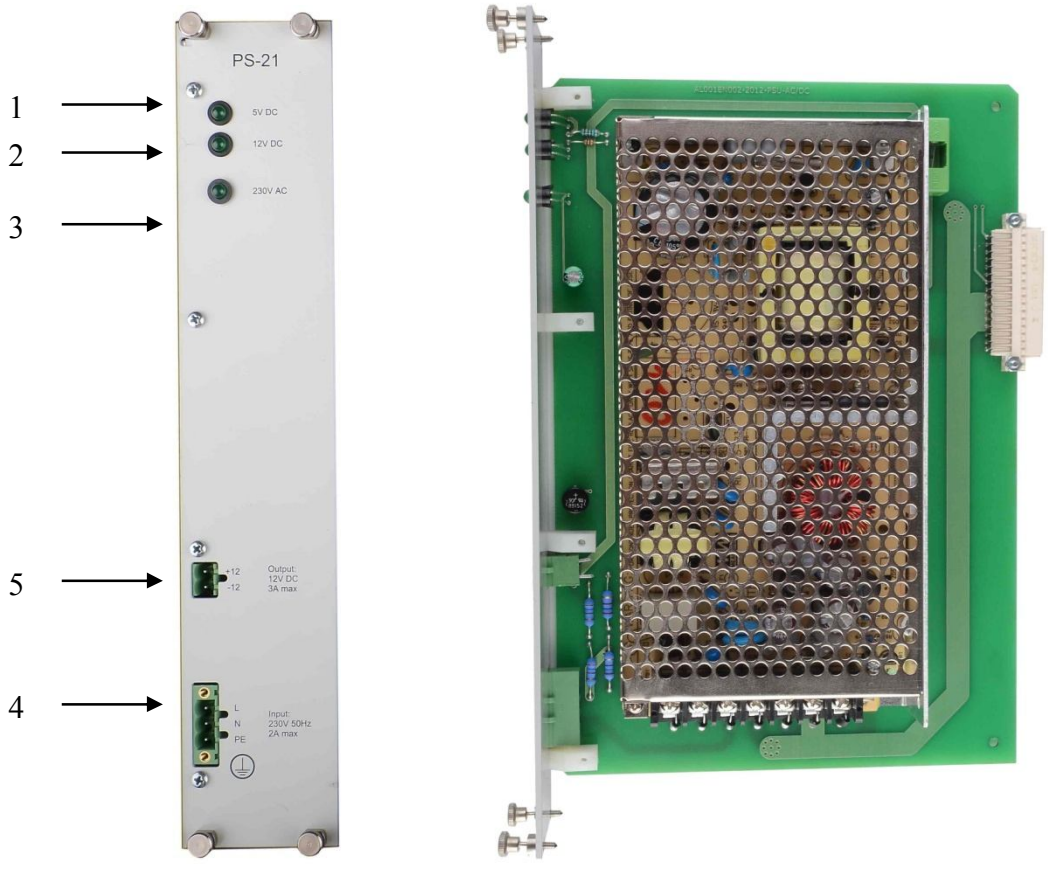


Figure 7. Power supply front and side view

No	Explanation	Note	Function	LED indication
1	LED indicator	5V	PS output voltage status	LED is ON - voltage is OK
2	LED indicator	12V	PS output voltage status	LED is ON - voltage is OK

3	LED indicator	110V AC, 230V AC, 110V DC, 220V DC	PS input voltage status	LED is ON - voltage is OK
4	Input voltage connection terminals			
5	12V DC output connection terminals			

3.6.1 Wiring diagram

Terminal	Function	
	AC Voltage	DC Voltage
L(+)	L1	+
N(-)	N	-
PE	Ground	Ground

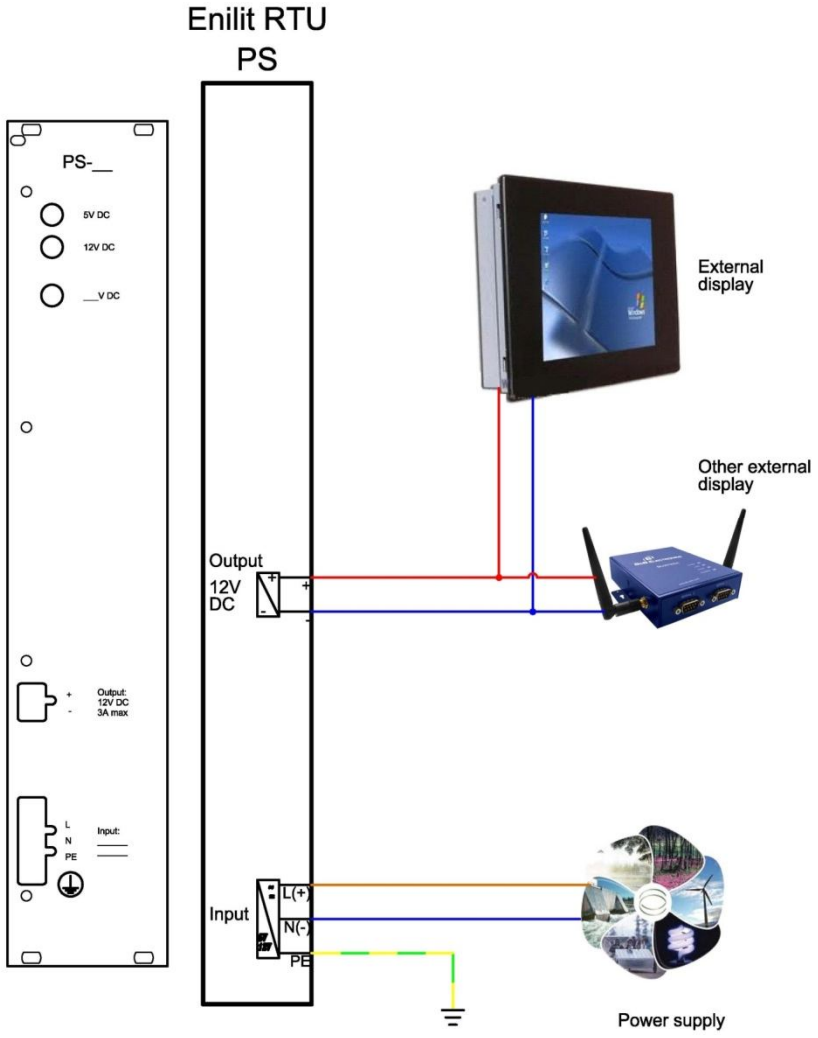


Figure 8. Power supply wiring diagram

3.6.2 Technical Data

Feature	Value	
Output voltage:	5V	12V
Rated current	7.7A	7.7A
Current range	2 ~ 15A	0.5 ~ 10A
Rated power	130.9W	
Setup rise time	500ms, 20ms/230V 1200ms, 30ms/115V at full load	
Hold up time (Typ.)	25ms/230V 30ms/115V at full load	
Input voltage range - Input voltage range PS 11 - Input voltage range PS 21 - Input voltage range PS 31 - Input voltage range PS 41	 88 ~ 132VAC 176 ~ 264VAC 88 ~ 132VDC 176 ~ 264VDC	
Frequency range	47 ~ 63Hz	
Current (Typ.)	3A/115V 2A/230V	
Inrush current (Typ.)	COLD START 40A/230V	
Leakage current	<2mA / 240VAC	
Working temperature	-25 ~ +70°C (Refer to output load derating curve)	
Working humidity	20 ~ 90% RH non-condensing	

3.7 Digital Input Module

The digital input module serves for the processing of up to 24 digital input signals.

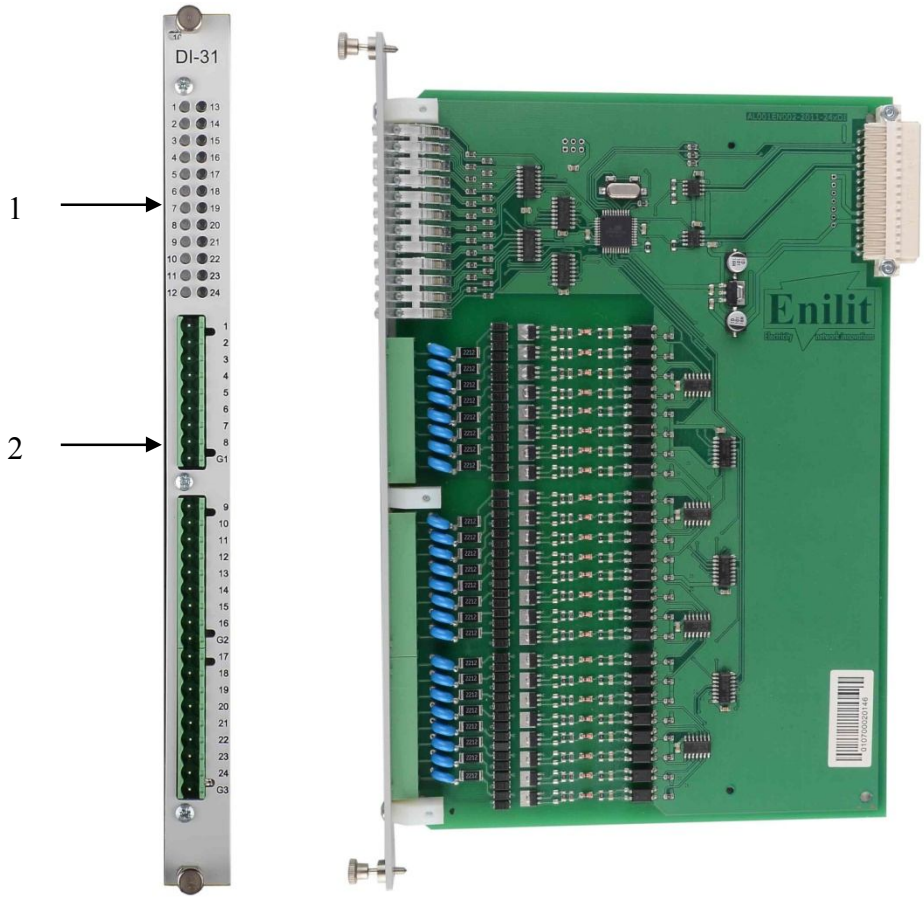


Figure 9. Digital input board front and side view

No	Explanation	Function	LED indication
1	LED indicators for each digital input	Digital input status	LED is ON – input is active; LED is OFF – input is inactive; ALL LEDS are blinking together – no connection with CPU or digital input board error.
2	Connection terminals	-	-

3.7.1 Wiring diagram

Terminal	Function
1	DI 1
2	DI 2
3	DI 3
4	DI 4
5	DI 5
6	DI 6
7	DI 7
8	DI 8
G1	COM
9	DI9
10	DI10
11	DI11
12	DI12
13	DI13
14	DI14
15	DI15
16	DI16
G2	COM
17	DI17
18	DI18
19	DI19
20	DI20
21	DI21
22	DI22
23	DI23
24	DI24
G3	COM

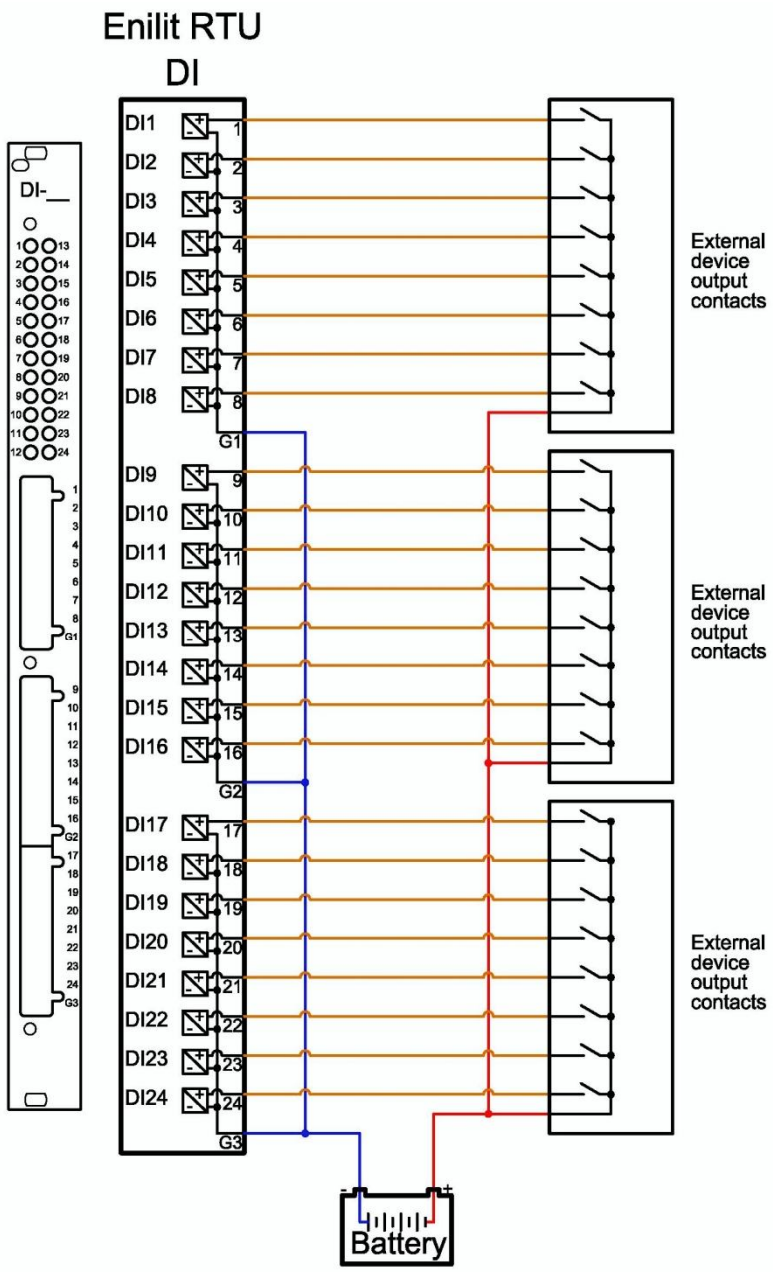


Figure 10. Digital input board wiring diagram

3.7.2 Technical Data

Feature	Value
No. of inputs	24
Time tag	1 ms
Galvanic isolation - from system electronics - of the channels from one another	 Yes (optocoupler) No (groups of 8 channels share a common ground)
Signaling-circuit voltage - Input voltage range DI 11 - Input voltage range DI 21 - Input voltage range DI 31 - Input voltage range DI 41	 24...30 V DC 39...72 V DC 88...150 V DC 175...264 V DC
Increased insulation resistance acc. to IEC 60255-5 - Power-frequency withstand voltage - Surge voltage	 2.5 kV ; 50 Hz, 1 min 4.4 kV; 1.2/50 µs; 0.5 J

3.8 Digital Output Module

The digital output module serves for the processing of up to 24 digital outputs.

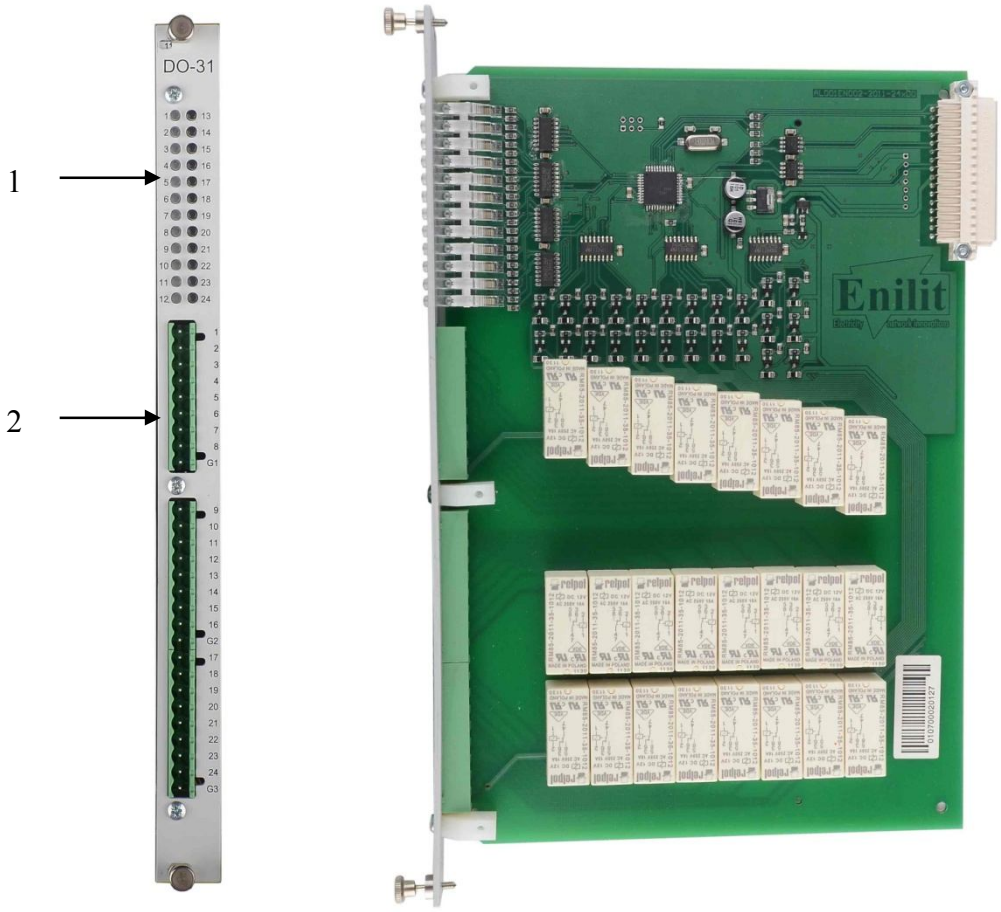


Figure 11. Digital output board front and side view

No	Explanation	Function	LED indication
1	LED indicators for each digital output	Digital output status	LED is ON – output is active; LED is OFF – output is inactive; ALL LEDS are blinking together – no connection with CPU or digital output board error.
2	Connection terminals		

3.8.1 Wiring diagram

Function	Function
1	DO1
2	DO2
3	DO3
4	DO4
5	DO5
6	DO6
7	DO7
8	DO8
G1	COM
9	DO9
10	DO10
11	DO11
12	DO12
13	DO13
14	DO14
15	DO15
16	DO16
G2	COM
17	DO17
18	DO18
19	DO19
20	DO20
21	DO21
22	DO22
23	DO23
24	DO24
G3	COM

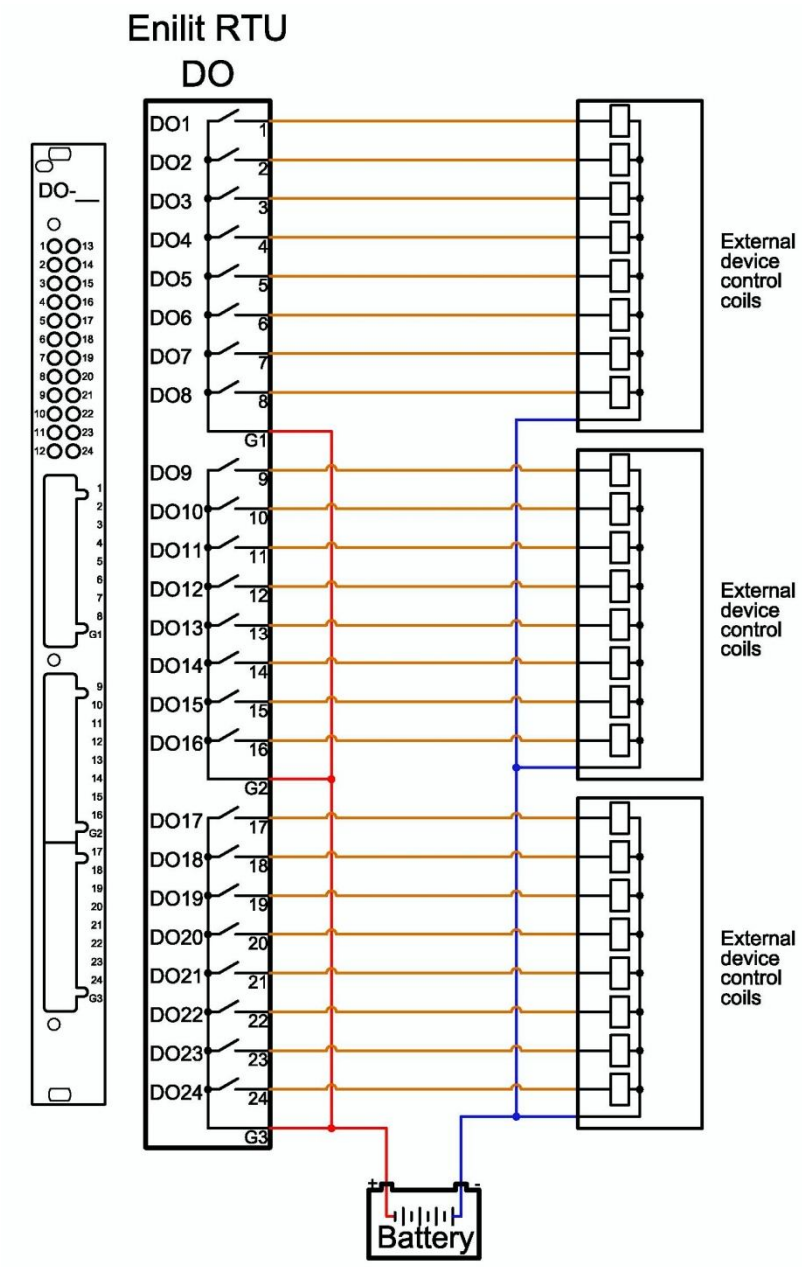


Figure 12. Digital output board wiring diagram

3.8.2 Technical Data

Feature	Value
No. of outputs	24
Galvanic isolation - from system electronics - of the channels from one another	 Yes (optocoupler) Yes
Switching capacity: AC1 AC15 AC3 DC1 DC13	 16 A / 250 V AC 3 A / 120 V 1,5 A / 240 V (B300) 750 W (single-phase motor) 16 A / 24 V DC (see Fig. 3) 0,22 A / 120 V 0,1 A / 250 V (R300)
Voltage (control circuit of the relay) - rated value - operating range	 12 V DC 3 ... 110 V
Increased insulation resistance acc. to IEC 60255-5 - Power-frequency withstand voltage - Surge voltage	 2.5 kV ; 50 Hz, 1 min 4.4 kV; 1.2/50 µs; 0.5 J

3.9 Analogue Input Module AI-31

The AI-31 analogue input module serves for the processing of up to twelve analogues, current or voltage input signals.

Note. Measuring current or voltage could be selected for each input separately by the internal jumper position.

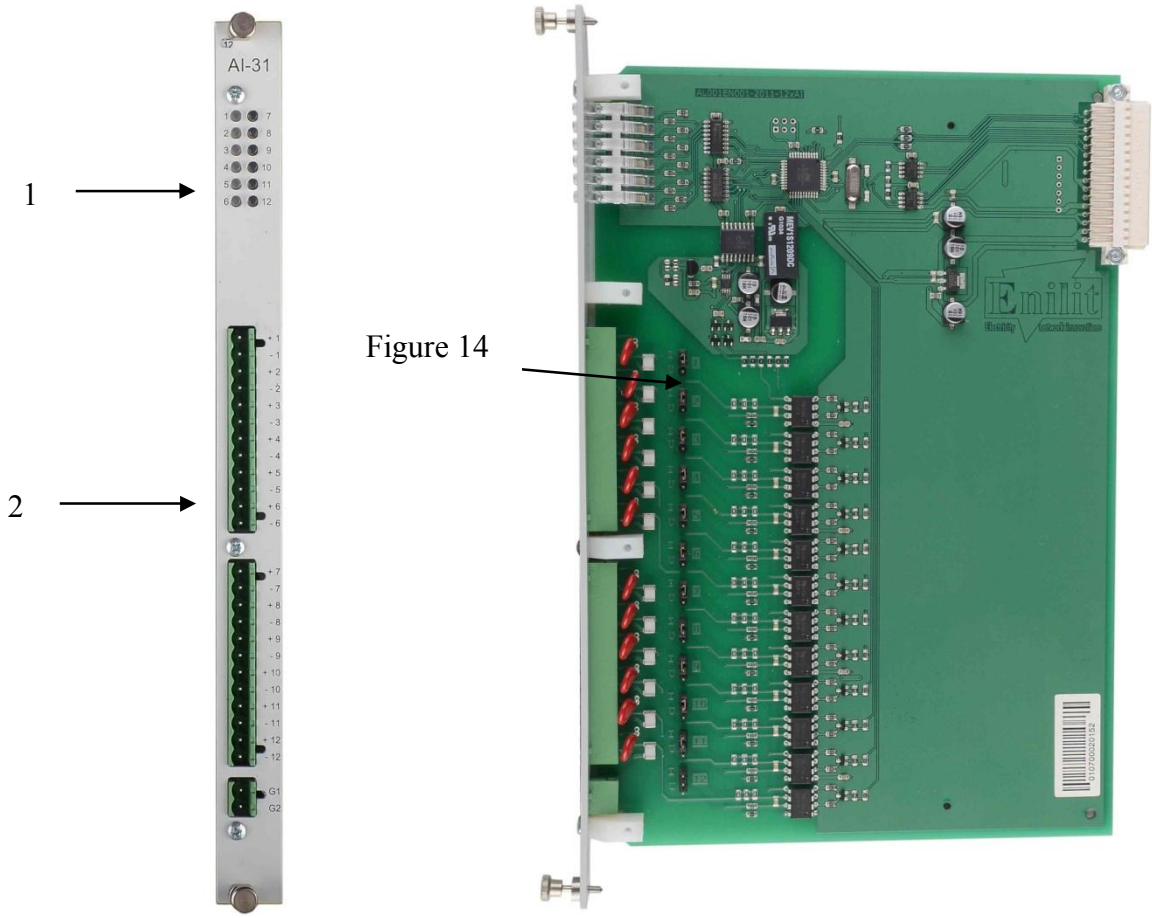
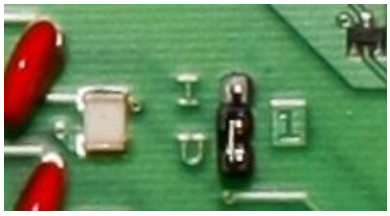


Figure 13. Analogue input board front and side view

Current -20 mA to +20 mA measuring



Voltage -10 V to +10 V measuring

Figure 14. Analogue input switch position

No	Explanation	Function	LED indication
1	LED indicators for each analogue input	Analogue input status	LED is OFF – normal measured value; LED is blinking – measured value is under or over range, ALL LEDS are blinking together – no connection with CPU or analog input board error.
2	Connection terminals		

3.9.1 Wiring diagram

Terminal	Function
+1	Analogue input 1+
-1	Analogue input 1-
+2	Analogue input 2+
-2	Analogue input 2-
+3	Analogue input 3+
-3	Analogue input 3-
+4	Analogue input 4+
-4	Analogue input 4-
+5	Analogue input 5+
-5	Analogue input 5-
+6	Analogue input 6+
-6	Analogue input 6-
+7	Analogue input 7+
-7	Analogue input 7-
+8	Analogue input 8+
-8	Analogue input 8-
+9	Analogue input 9+
-9	Analogue input 9-
+10	Analogue input 10+
-10	Analogue input 10-
+11	Analogue input 11+
-11	Analogue input 11-
+12	Analogue input 12+
-12	Analogue input 12-
G1	Ground
G2	Ground

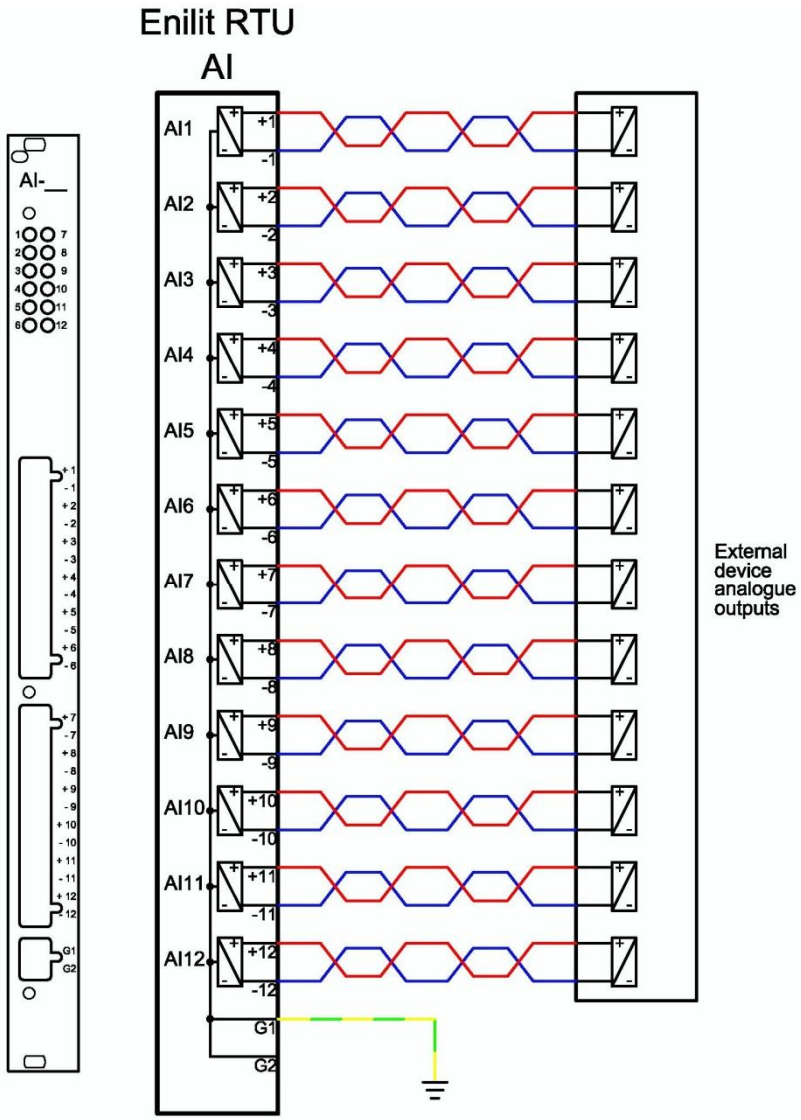


Figure 15. Analogue input board wiring diagram

3.9.2 Technical Data

Feature	Value
No. of inputs	12
Galvanic isolation - from system electronics - of the channels from one another	 Yes (optocoupler) Yes
Measuring ranges (standard fitting)	Configurable via switch
Resolution in all ranges	16 bit
Acquisition cycle max.	100 ms
Increased insulation resistance acc. to IEC 60255-5 - Power-frequency withstand voltage - Surge voltage	 2.5 kV ; 50 Hz, 1 min 4.4 kV; 1.2/50 µs; 0.5 J

3.10 Fiber optic module ST-61

The ST-61 is designed to provide communication from six fiber optic ports to one RS-422/RS-485 serial port. The ST-61 uses a separate LED emitter and photo-detector operating at an 820 nm wavelength. Connections to the emitter and detector are done with ST type connectors. Almost any multimode glass fiber size can be used including 50/125 µm, 62.5/125 µm, 100/140 µm, and 200 µm. Two fibers are required between the two devices, one each direction of data.

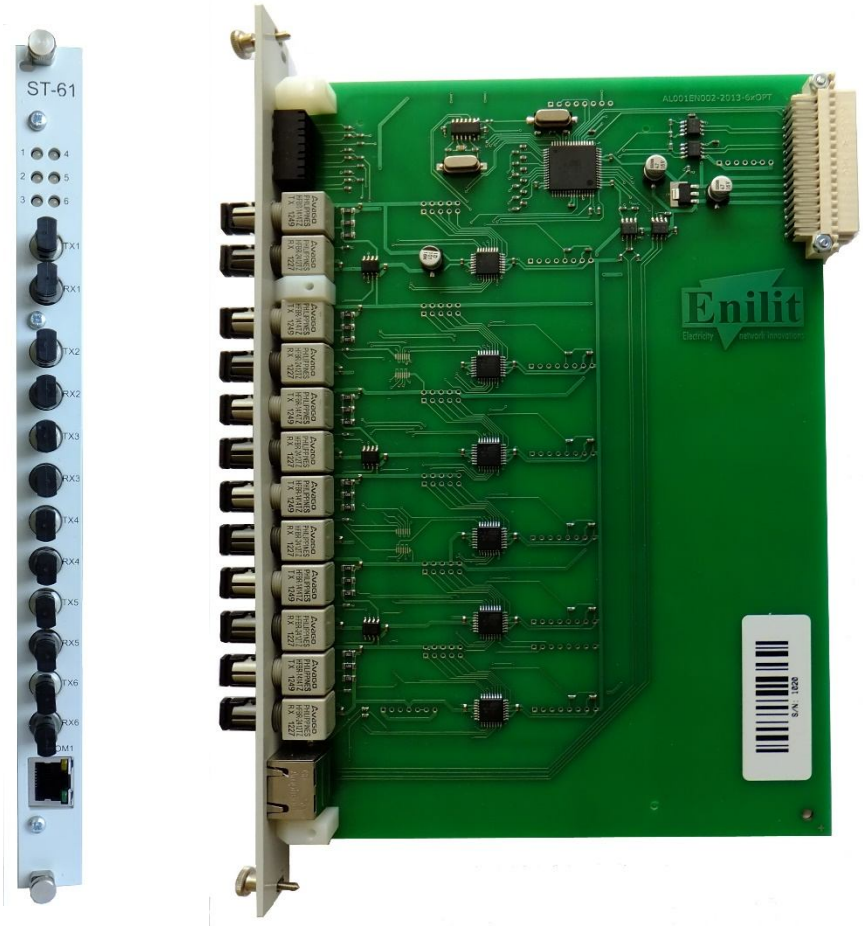


Figure 16. Fiber optic board

3.11 Installation of System Housing

Multi-frame systems/RTUs are usually installed in a cabinet (horizontal installation). A station's height is 6 height units (U), i.e. 266 mm. It is important to leave one U free between two stations in order to allow for sufficient ventilation.

Another possibility is to install the RTUs in a swing frame or on a mounting plate.

Note. The RTUs should be installed in a dry, clean environment with an ambient temperature range of 0 °C ... + 60 °C (standard) and an air humidity of 0 … 95 % (non-condensation).

3.12 Order-book

3.12.1 Basic frame

Enilit RTU order number:	Enilit RTU 232-123456900003-111111-0																								
Slot Nr.	1	3	6		10	11	12	13	14	15	16	17	18	19	20	21									
Choice row	**2**	**3**	**2**	**-**	**1**	**2**	**3**	**4**	**5**	**6**	**9**	**0**	**0**	**0**	**0**	**3**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**0**
Functions																									
Power supply																									
PS-11, auxiliary voltage 115V AC	1	1																							
PS-21, auxiliary voltage 230V AC	2	2																							
PS-31, auxiliary voltage 110V DC	3	3																							
PS-41, auxiliary voltage 220V DC	4	4																							
Without redundant power supply	0	0																							
CPU module																									
CPU 31, with 3 Ethernet RJ45, 12 RS485 Serial links			1																						
CPU 32, with 3 Ethernet RJ45, 4 RS232 Serial links, 8 RS485 Serial links			2																						
CPU 33, with 3 Ethernet RJ45, 8 RS232 Serial links, 4 RS485 Serial links			3																						
CPU 34, with 3 Ethernet RJ45, 12 RS232 Serial links			4																						
CPU 41, with 3 Ethernet RJ45, 12 RS485 Serial links			5																						
CPU 42, with 3 Ethernet RJ45, 4 RS232 Serial links, 8 RS485 Serial links			6																						
CPU 43, with 3 Ethernet RJ45, 8 RS232 Serial links, 4 RS485 Serial links			7																						

CPU 44, with 3 Ethernet RJ45, 12 RS232 Serial links			8																				
Inputs / outputs boards																							
DI 11, 24 x DI, operating voltage 24 VDC					1	1	1	1	1	1	1	1	1	1	1	1							
DI 21, 24 x DI, operating voltage 48 VDC					2	2	2	2	2	2	2	2	2	2	2	2							
DI 31, 24 x DI, operating voltage 110 VDC					3	3	3	3	3	3	3	3	3	3	3	3							
DI 41, 24 x DI, operating voltage 220 VDC					4	4	4	4	4	4	4	4	4	4	4	4							
DO 31, 24 x DO					5	5	5	5	5	5	5	5	5	5	5	5							
AI 31, 12 x AI					6	6	6	6	6	6	6	6	6	6	6	6							
ST 61, 6 x FO, fiber optic connector type ST					9	9	9	9	9	9	9	9	9	9	9	9							
Without board					0	0	0	0	0	0	0	0	0	0	0	0							
Communications																							
IEC 60870-5-101 (serial communication protocol to upper or lower levels)																	1						
IEC 60870-5-104 (ethernet-based communication protocol to upper or lower levels)																		1					
IEC 61850 (ethernet-based communication protocol to upper or lower levels)																			1				
IEC 60870-5-103 (legacy IED communication protocol to lower levels)																				1			
DNP3, Modbus																					1		
Without communication protocol																	0	0	0	0	0		
PLC Automation																							
Enabled ISaGRAF run-time for Programmable Logic, Automation, etc.																						1	
Disabled																						0	
Frame																							

With second frame																								1
Without second frame																								0
Accessories																								
Equipments:																								
Wall mounted adapter																								
Ethernet cable for any connection																								
Cache for empty slots																								
Connectors (3 points)																								
Connectors (9 points)																								
Connectors (12 points)																								
Softwares:																								
Enilit RTU configuration tool always included in order																								
ISaGRAF software PLC Editor																								
Manuals:																								
Technical and Operation guides in English																								
Technical and Operation guides in German																								
Technical and Operation guides in Russian																								
Technical and Operation guides in Lithuanian																								

3.12.2 Second frame

Enilit RTU ordernumber:	Enilit RTU 30-1234569090909090																		
Slot Nr.	1	3		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Choicerow	**3**	**0**	**-**	**1**	**2**	**3**	**4**	**5**	**6**	**9**	**0**	**9**	**0**	**9**	**0**	**9**	**0**	**9**	**0**
Functions																			
Power supply																			
PS-11, auxiliaryvoltage 115V AC	1	1																	
PS-21, auxiliaryvoltage 230V AC	2	2																	
PS-31, auxiliaryvoltage 110V DC	3	3																	
PS-41, auxiliaryvoltage 220V DC	4	4																	
Withoutredundantpowersupply	0	0																	
Inputs / outputsboards																			
DI 11, 24 x DI, operatingvoltage 24 VDC				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DI 21, 24 x DI, operatingvoltage 48 VDC				2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
DI 31, 24 x DI, operatingvoltage 110 VDC				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DI 41, 24 x DI, operatingvoltage 220 VDC				4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DO 31, 24 x DO				5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
AI 31, 12 x AI				6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
ST 61, 6 x FO, fiberopticconnectortype ST				9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Withoutboard				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accessories																			
Equipments:																			
Wallmountedadapter																			
Ethernetcableforanyconnection																			
Cacheforemptyslots																			
Connectors (3 points)																			
Connectors (9 points)																			
Connectors (12 points)																			

4. Enilit RTU software

4.1 Introduction

The Enilit RTU Configuration and Management Software (CMS) is the tool for simple and straightforward configuration, maintenance, management and PLC programming of Enilit RTU with IsaGRAF software. In the course of RTU configuration, the user can specify communications protocols and define relationships between master and slave protocols. Also you can define relationships between hardware connections and slave protocols. Supported protocols are:

- control direction:
  - IEC 60870-5-101
  - IEC 60870-5-103
  - IEC 60870-5-104
  - DNP3 serial
  - DNP3 IP
  - IEC 61850
  - Modbus RTU/ASCII
  - Modbus TCP
  - RP-570
- monitor direction:
  - IEC 60870-5-101
  - IEC 60870-5-104
  - DNP3 serial
  - DNP3 IP

Enilit RTU can be used as gateway between the IEC61850 substation bus and SCADA protocols IEC 60870-5-101 and -104.

4.2 System capabilities

Enilit RTU CMS capabilities:

- Not less than 50.000 information objects database;
- Not less than 1000 events/second.
- Up to 96 serial slave devices

4.3 Licensing

Enilit RTU CMS software is included by default.

Windows 7 Embedded operating system license is included in the Enilit RTU price.

IsaGRAF license can be added by the request.

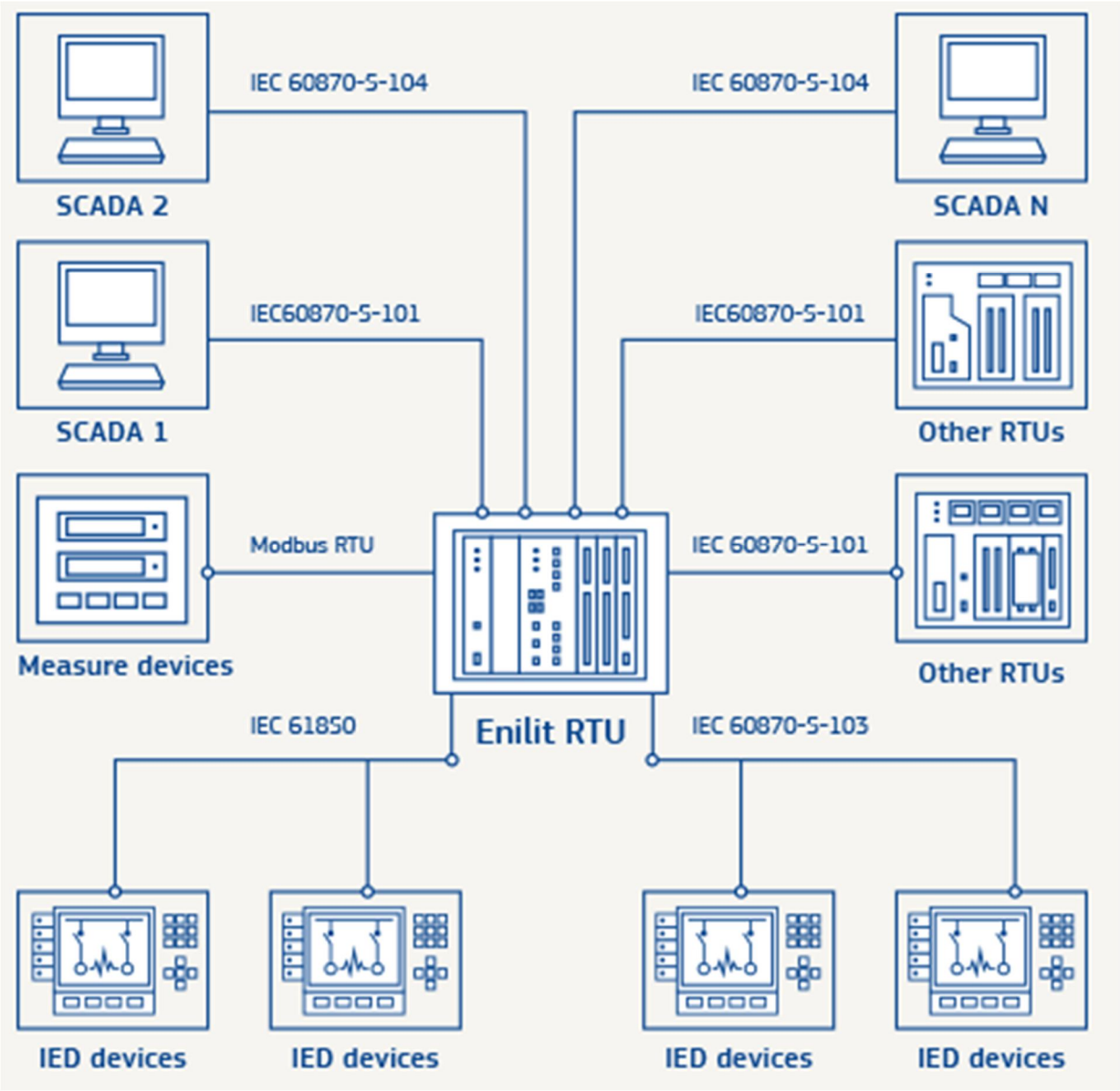


Figure 17. Enilit RTU Substation and SCADA system concept

4.4 User interface

Following figure shows Main window of Enilit RTU CMS. You can choose one of the buttons to configure Master protocols, Slave protocols, Hardware, PLC Isagraf or enter Tag manager. The main architectural concept is that you create some points in Master protocols from IED devices then you create tags with Tag manager and connect it to the Master protocols points. Then you create points in Slave protocols and connect it to the tags, which you have created before. And now you will have some points from controlled device to the SCADA or some other controlling device. In the Main window you can save Enilit RTU configuration to the hard disk.

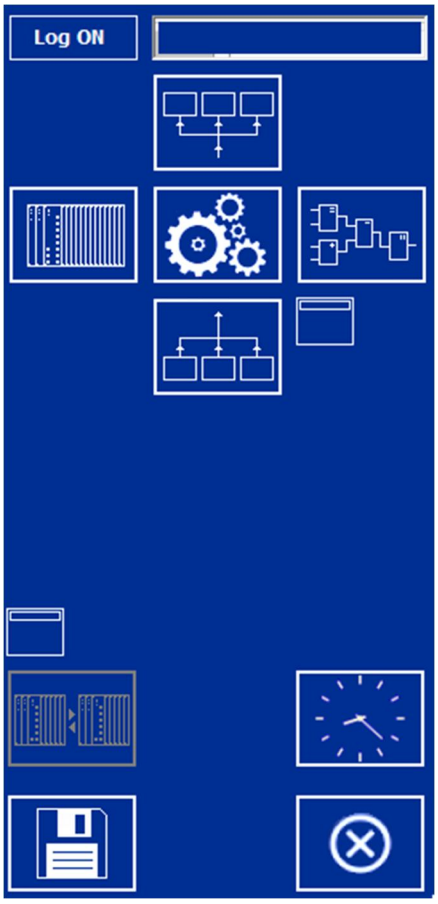
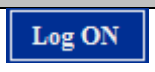
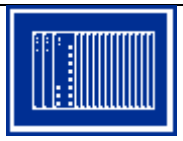
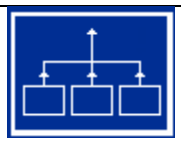
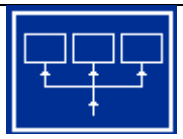
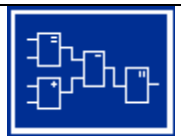


Figure 18. Main window

Menu item	Description
	Click to log on as a user.
	Click to open Hardware manager.

	Click to open Master protocols.
	Click to open Slave protocols.
	Click to open PLC programming interface.
	Click to open TAG manager.
	Click to open TAG states window.
	Click to open Redundancy management window (button is visible only if Redundancy is used)
	Click to open Time management window.
	Click to open Console window.
	Click to save configuration.
	Click to close Enilit RTU software.

The following figure shows the standard perspective of the program window of Enilit RTU CMS. The display and work area is subdivided into several views. As is usual with all Windows applications, all windows can be resized, moved or closed.

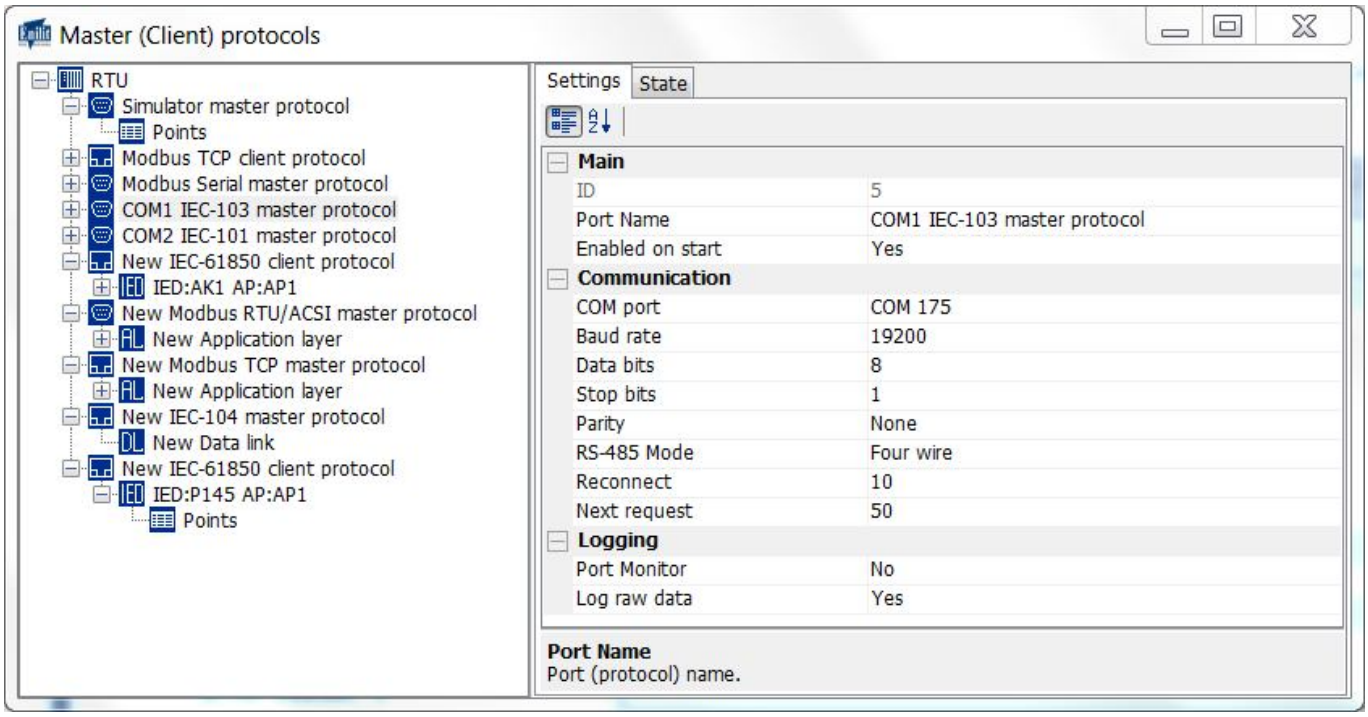


Figure 19. Standard application window

The program window is subdivided in the following areas:

Side	Description
Left side	Communications tree. RTU of a project and their respective communications are shown in the form of a structured tree diagram. In this view you can use the "+" and the "-" characters, respectively, to open and close the different branches of the tree. By clicking left mouse button on the tree item, the user opens settings window in the right application side. When clicking on tree item with the right mouse button, a corresponding popup menu enables access to further functions available for this tree item.
Right side	Settings table. When clicking on tree item in left side of window, the corresponding Settings table is opened, enabling the user to view and edit the settings.
Help section	Help section is located in the bottom of the right side. The help section contains some information about the parameter on which the cursor is currently positioned.

The following figure shows popup menu of first tree item (CPU).Menu items:

Menu item	Description
Expand All	Expand all tree branches
Collapse All	Collapse all tree branches

Create New Communication Port	Shows window in which you can choose protocol. Keyboard shortcut *Ctrl+N*.

Figure 20. CPU popup menu

If you use menu item Create New Communication Port, you will see following figure. Then you can select protocol. The new tree item will appear in the communications tree. Popup menu is fast and simple way for creating RTU communications.

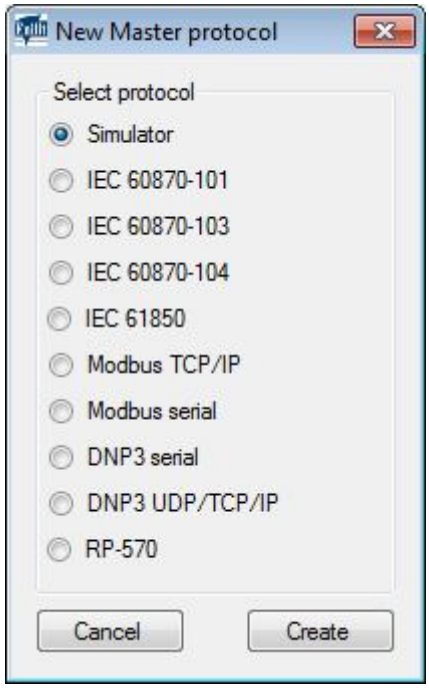


Figure 21. Select Master protocol window

The following window shows Select Slave protocol window.

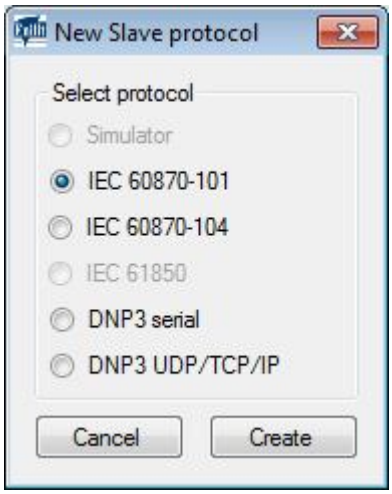


Figure 22. Select Slave protocol window

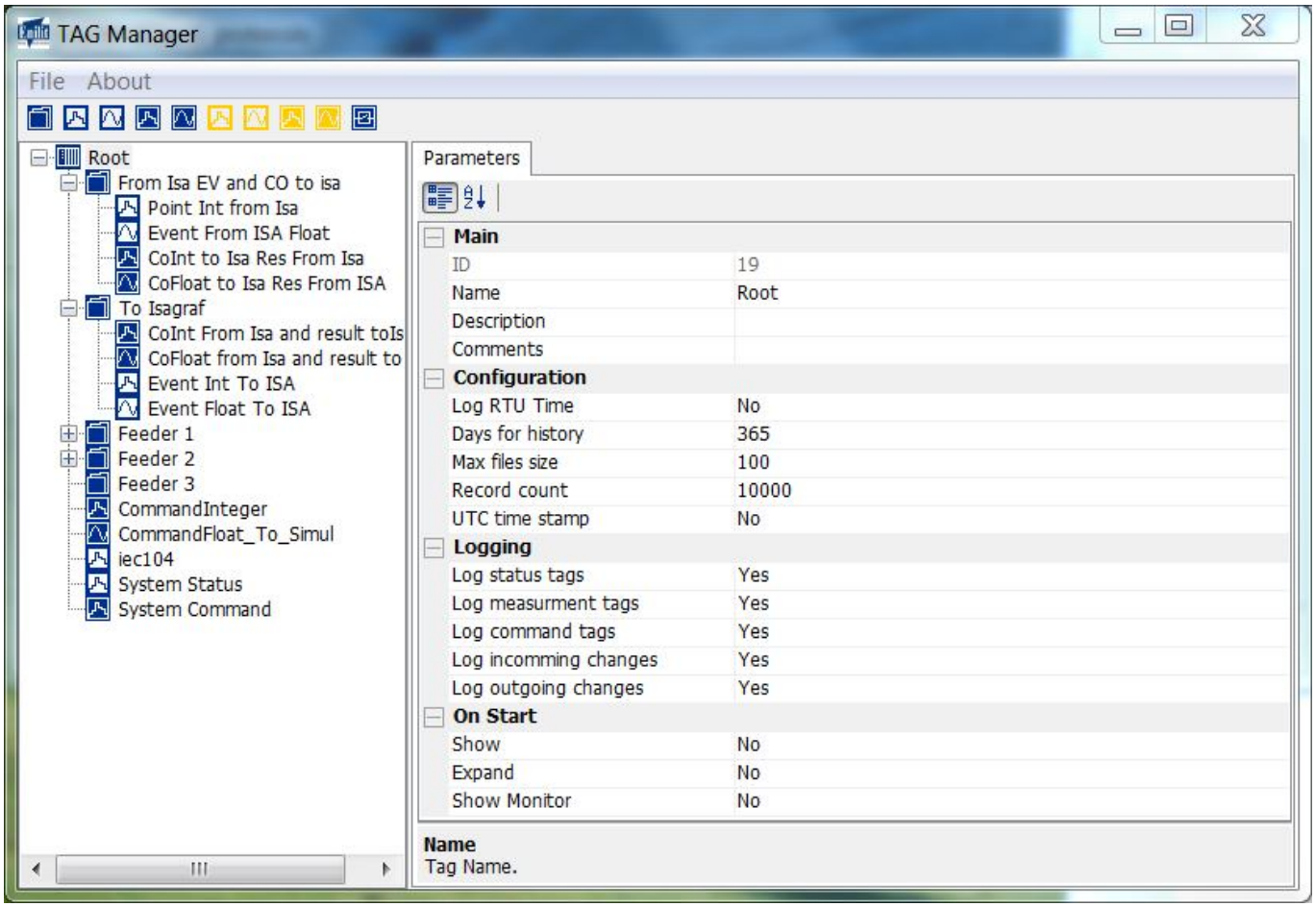


Figure 23. Tag Manager window

4.5 Configurator

With the help of Enilit RTU Configurator you can change some initial system parameters regarding with CPU, Serial ports, Ethernet ports, OPC, Isagraf, Graphics, Logs, Debug and other.

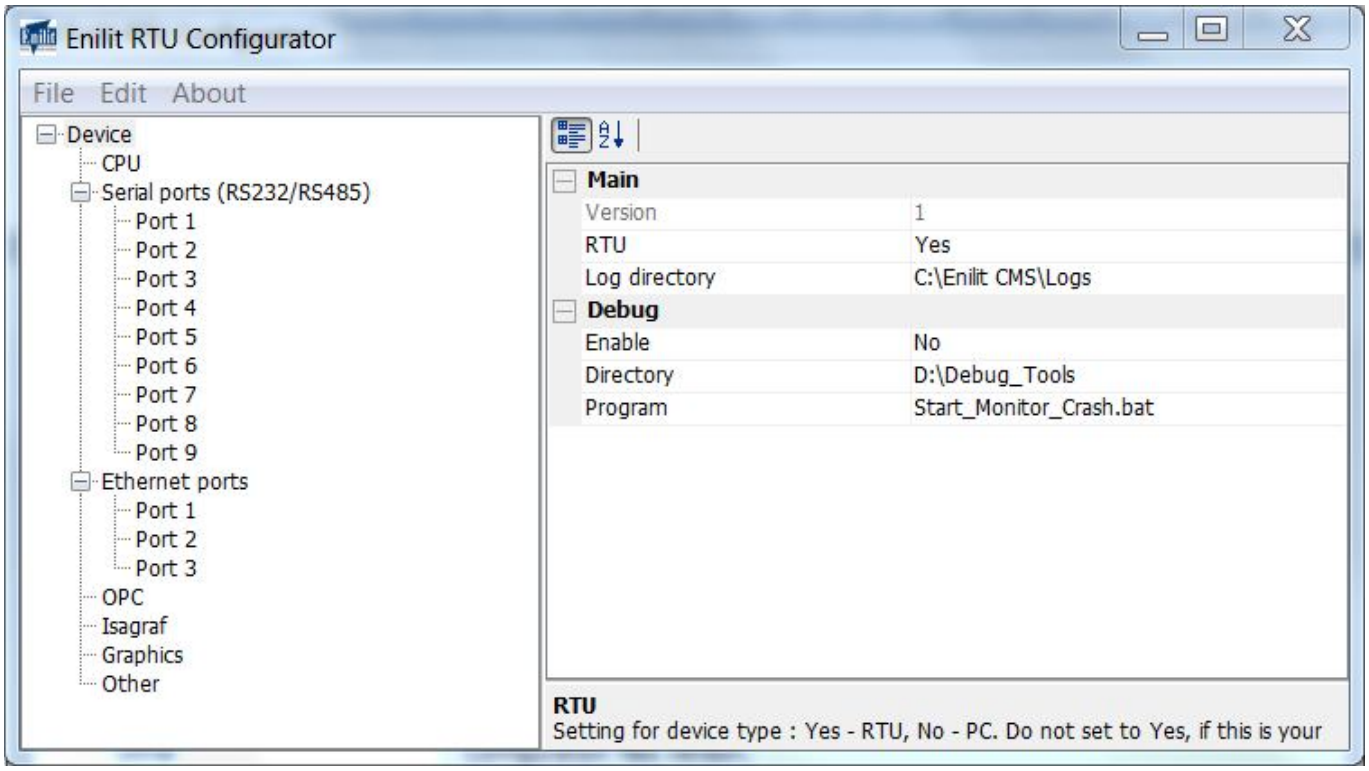


Figure 24. Configurator window

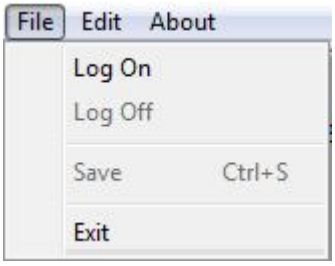


Figure 25. File menu

Menu item	Description
Log On	Log on as a user.
Log Off	Log off currently logged user.
Save (Ctrl+S)	Save configuration
Exit	Exit Configurator

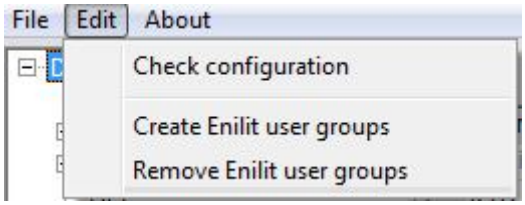


Figure 26. File menu

Menu item	Description
Check configuration	Checks RTU description file
Create Enilit user groups	Creates Enilit user groups in Windows user groups list
Remove Enilit user groups	Removes Enilit user groups from Windows user groups list

4.5.1 User groups

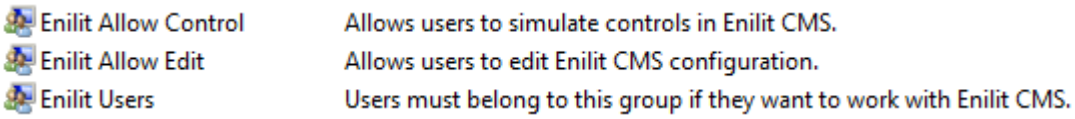

Enilit Allow Control
Allows users to simulate controls in Enilit CMS.
Enilit Allow Edit
Allows users to edit Enilit CMS configuration.
Enilit Users
Users must belong to this group if they want to work with Enilit CMS.

Figure 27. Created user groups in Windows user groups list

There are three groups of users:

Menu item	Description
Enilit Users	Users must belong to this group if they want to work with Enilit CMS.
Enilit Allow Control	Allows users to simulate controls in Enilit CMS.
Enilit Allow Edit.	Allows users to edit Enilit CMS configuration.

4.5.2 Create user groups

First step to start working with Enilit RTU software is to *Create Enilit user groups* from Enilit RTU Configurator.

To create Enilit user groups in Windows user group list you can use Enilit Configurator. Run Enilit Configurator program and select from the menu *Edit*, then *Create Enilit user groups.* Successful creation shows the following figure. You can use this function without log in.

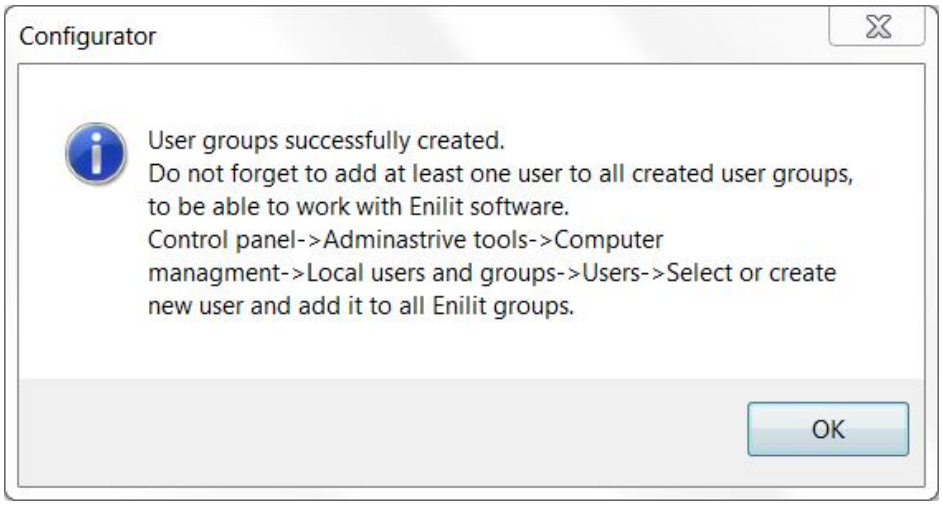

Configurator
User groups successfully created.
Do not forget to add at least one user to all created user groups,
to be able to work with Enilit software.
Control panel->Adminastrive tools->Computer
managment->Local users and groups->Users->Select or create
new user and add it to all Enilit groups.
OK

Figure 28. User groups successfully created.

4.5.3 Create user with rights

Second step, open *Computer Management* tool from *Control Panel*, *Administrative Tools*. *Go to Local Users and Groups*. Create new user in *Users* folder, like shown in following figure.

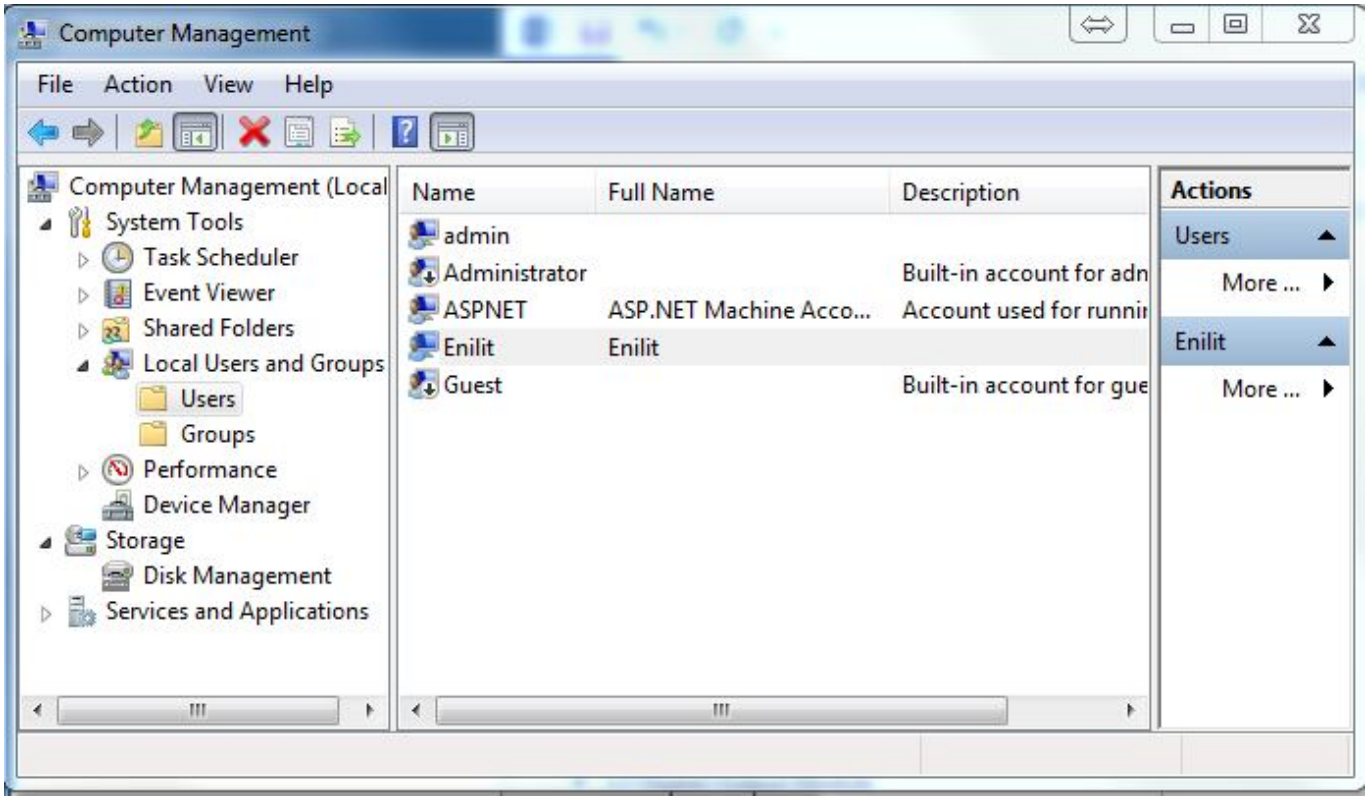


Figure 29. Computer management window

In the General tab of Enilit User properties uncheck *User must change password at next logon* checkbox, and check *Password never expires* checkbox.

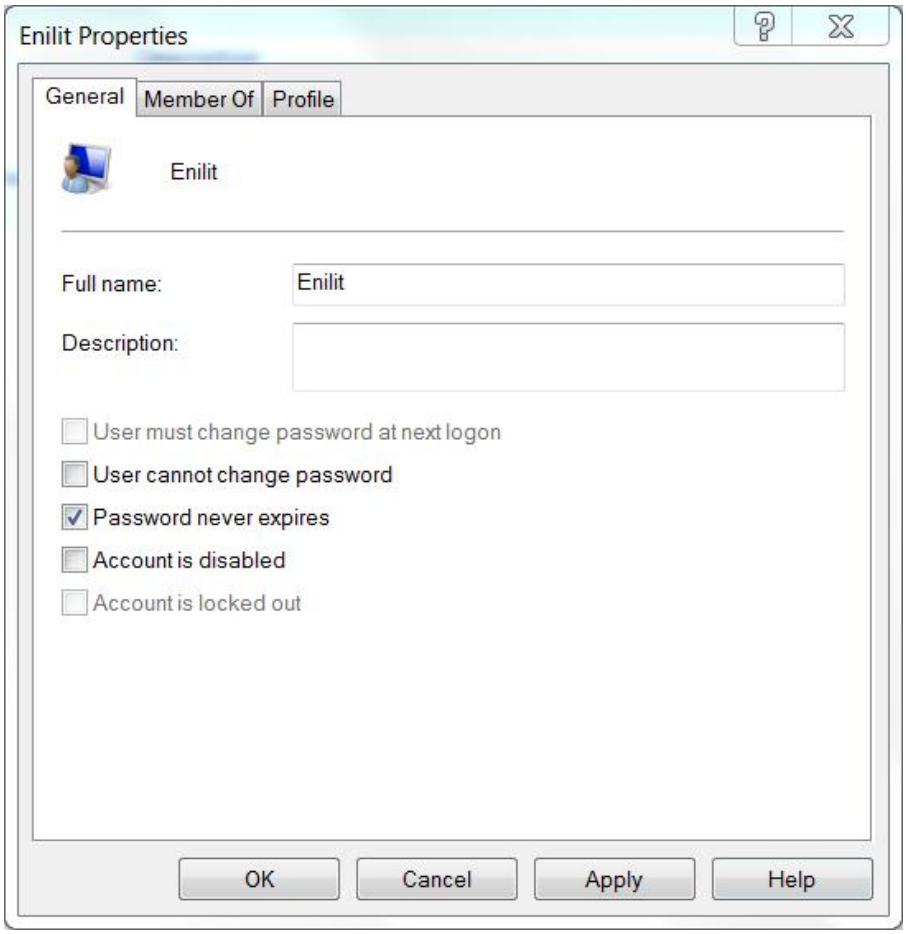


Figure 30. Enilit user password options

After that open created user properties window and click *Member Of* tab, then *Add* new Groups.

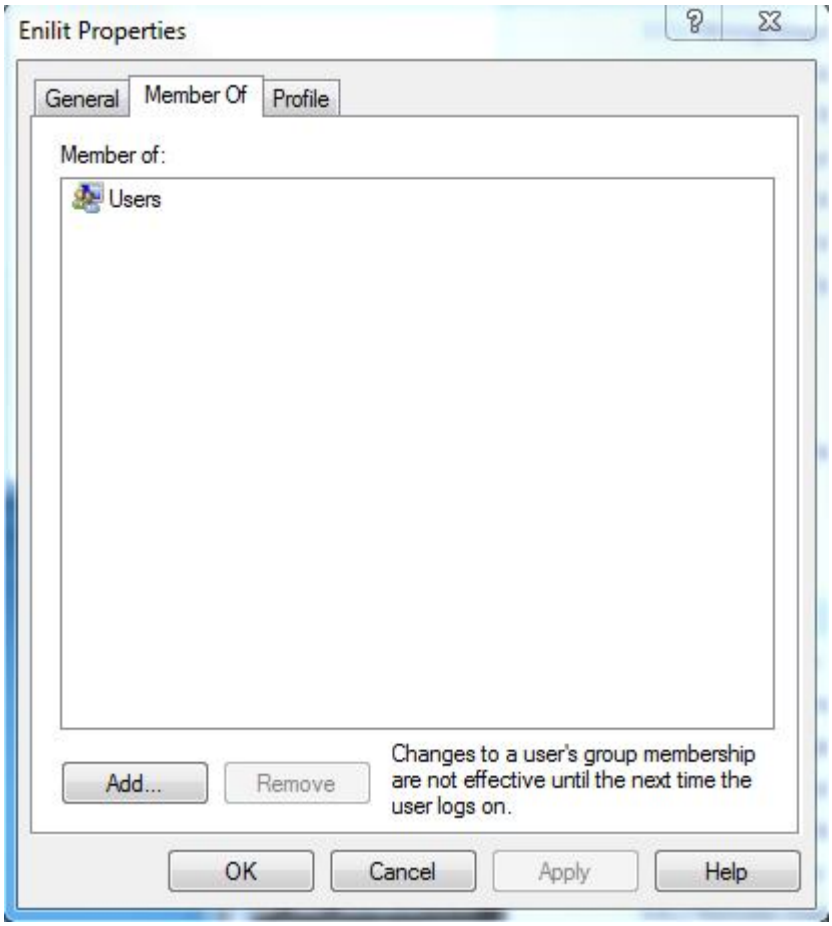


Figure 31. User properties window

Click *Advanced*.

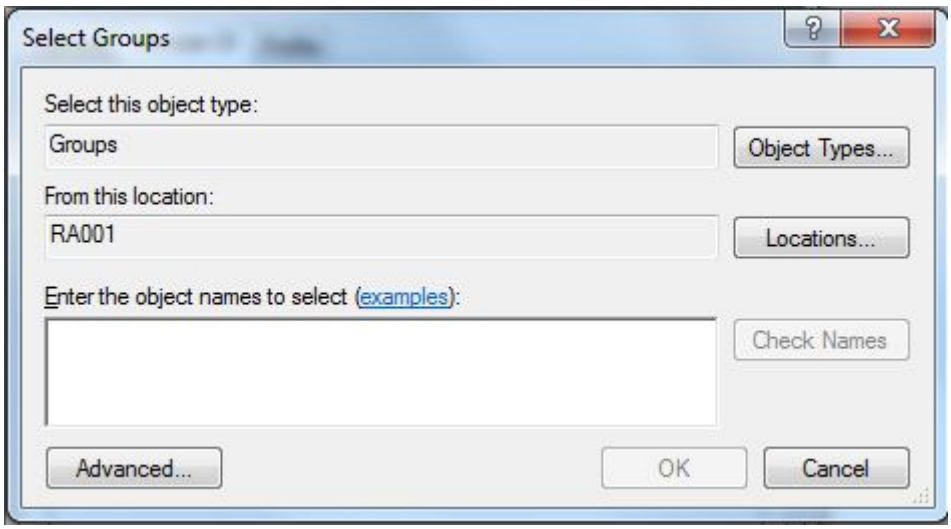


Figure 32. Select group window

Select all Enilit user groups and click *OK*.

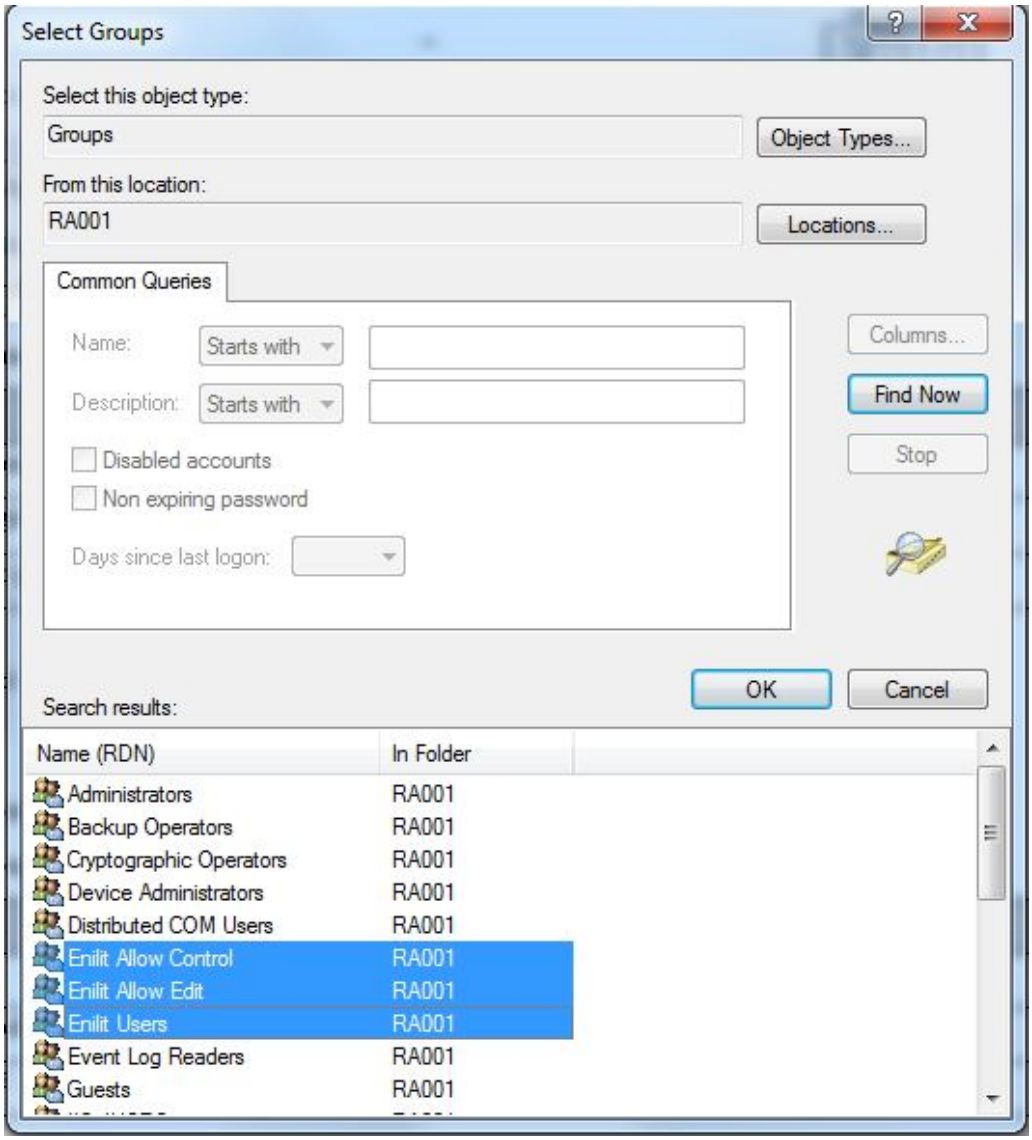


Figure 33. Advanced Select group window

Following figure shows how should look *Member Of* tab in the last step. Click *OK* and you will have user with the rights to log in, configure and control Enilit RTU Configurator, Enilit RTU Project Manager and Enilit RTU CMS. User with all three groups will have full access to the Enilit RTU software, but if you need users with different access level you can add only Enilit Users or Enilit Allow Edit.

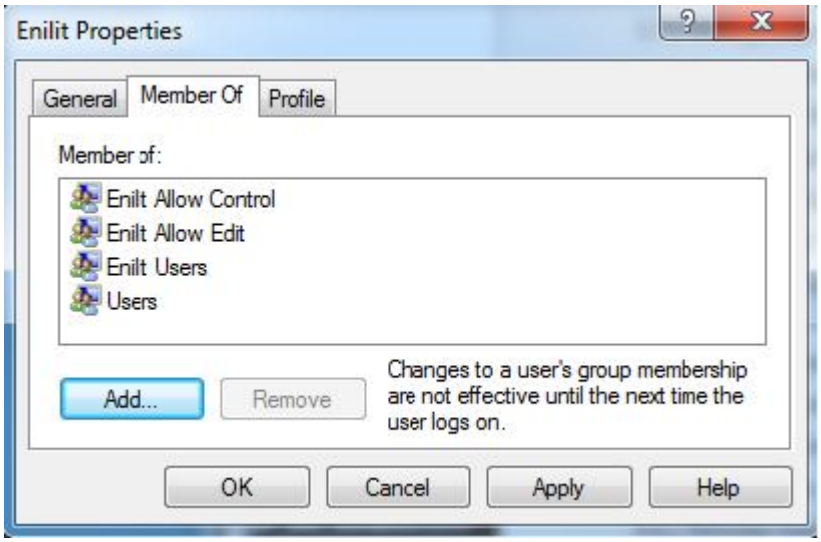


Figure 34. User Member of tab

4.6 Users authentication

After run of Configurator, Project Manager or CMS user must authenticate himself with own user name and password.

Figure 35. Log on window

Without user registration you can only review configuration, but not able to do anything else. Even without user log on, you can't manually start/stop RTU with current configuration. After user log on you will see in the Main window user name which have logged on.

The following figure shows that logged on user: Enilit.

Figure 36. Logged on user

4.7 Project manager

4.7.1 Basic information

With the help of Project Manager you can manage Enilit RTU configurations. It allows import/export project of Enilit RTU configuration. You can have here many projects and start Enilit RTU CMS with specific RTU configuration.

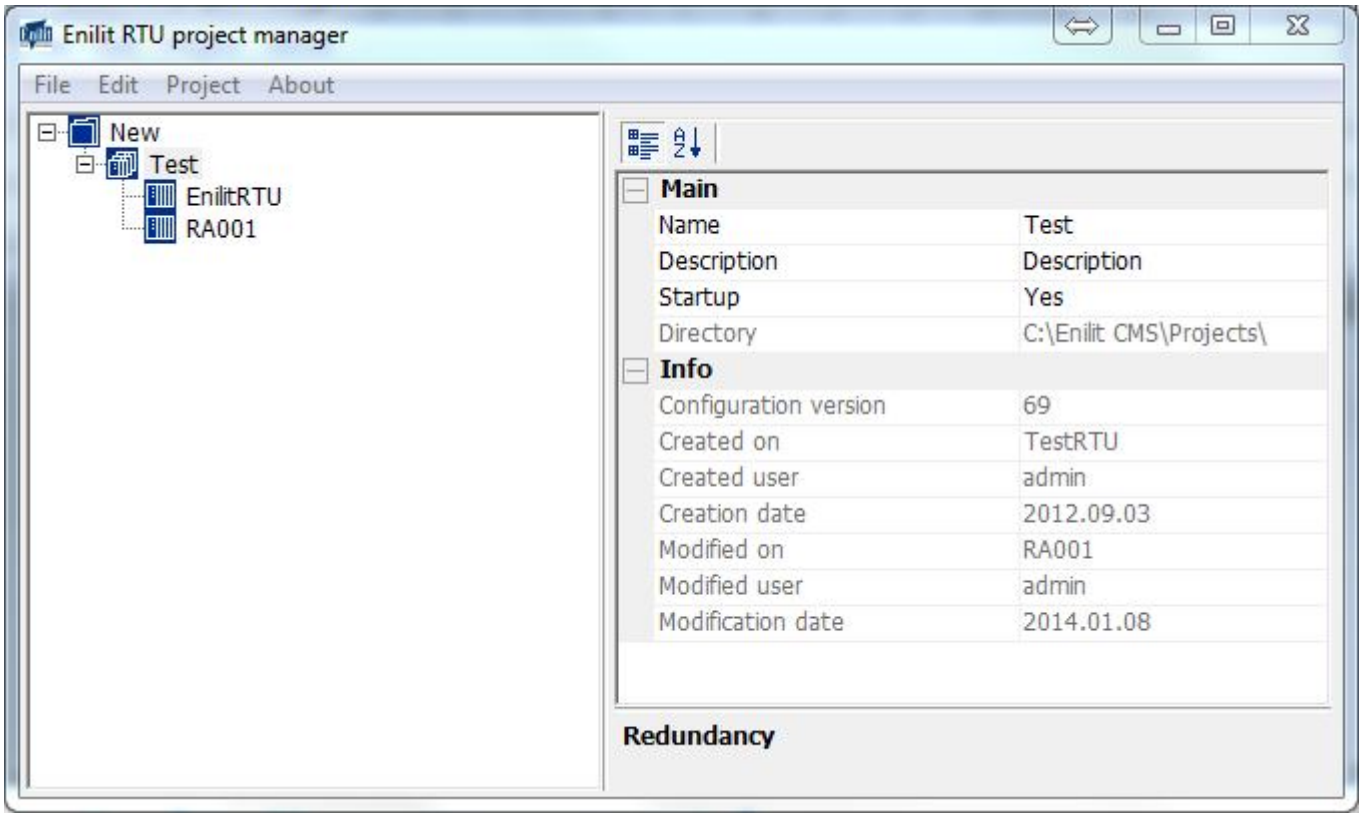


Figure 37. Project Manager project parameters window

Menu item	Description
Name	Project name
Description	Additional project description
Startup	If enabled, then project is startup project
Directory	Projects directory (read-only). Change possible only in Projects.xml file in *Enilit CMS* directory.
Configuration version	Version of project configuration
Created on	RTU of computer name on which project is created
Created user	User who created the project
Creation date	Date when the project was created

Modified on	Computer name on which was made last modification
Modified user	User who made last modification
Modification date	Date when was last modification

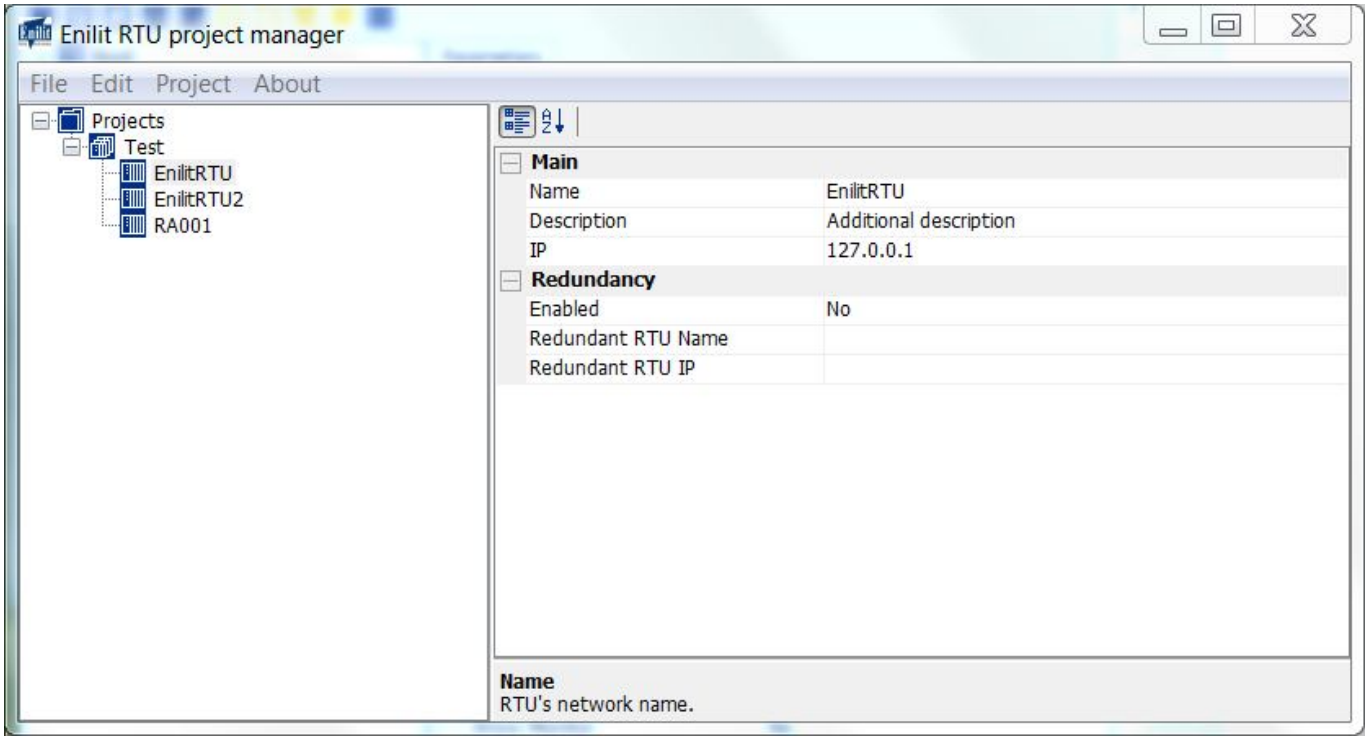


Figure 38. Project Manager RTU parameters window

Menu item	Description	Default value
Name	Name of RTU	EnilitRTU
Description	Additional description	Additional description
IP	IP address to connect to RTU	127.0.0.1
Enabled	Enables Redundancy	No
Redundant RTU Name	Redundant RTU name	Empty
Redundant RTU IP	IP address of redundant RTU	Empty

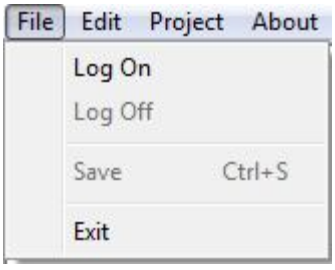


Figure 39. File menu

Menu item	Description
Log On	Log on as a user.
Log Off	Log off currently logged user.
Save (Ctrl+S)	Save Project Manager configuration
Exit	Exit Project Manager

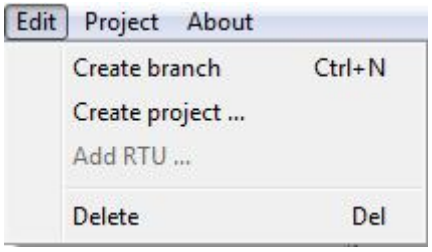


Figure 40. Edit menu

Menu item	Description
Create branch (Ctrl+N)	Create branch in the tree
Create project…	Create Project in the selected branch
Add RTU…	Add RTU to the selected project
Delete	Delete branch, project or RTU

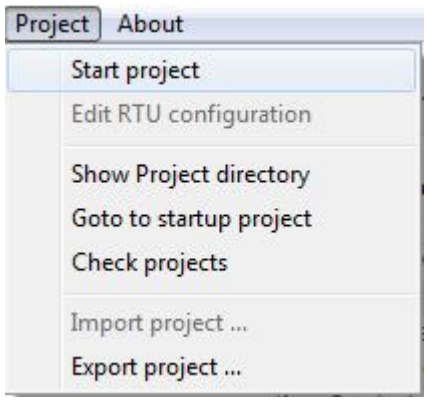


Figure 41. Project menu

Menu item	Description
Start project	Start Enilit RTU CMS with the selected project
Edit RTU configuration	Edit Enilit RTU configuration with CMS
Show Project directory	Opens project directory
Go to startup project	Selects startup RTU in the projects tree
Check projects	Validates projects
Import project	Import project from ezip file (Enilit ZIP)

Export project	Export project to ezip file (Enilit ZIP)

4.7.2 Import project

With the Import project feature you can import project from external, network or other storage.

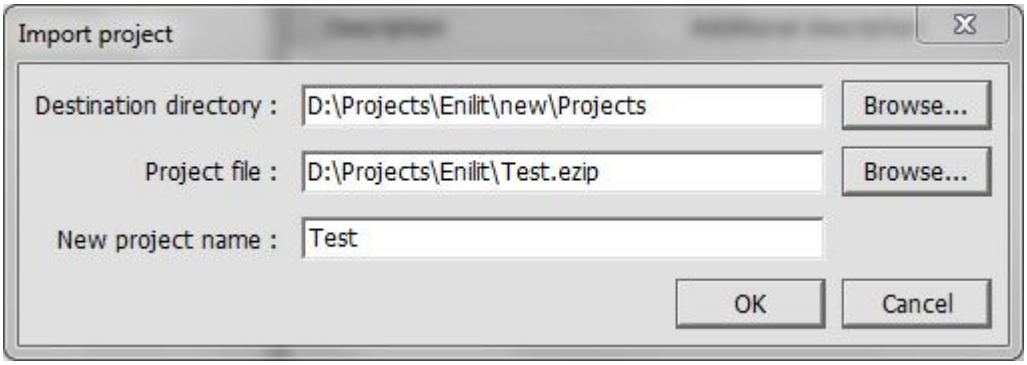


Figure 42. Import project window

Menu item	Description
Destination directory	Directory where to save imported project
Project file	Ezip file of importing project
New project name	New imported project name

4.7.3 Export project

With the Export project feature you can export project to external, network or other storage for RTU configuration backup.

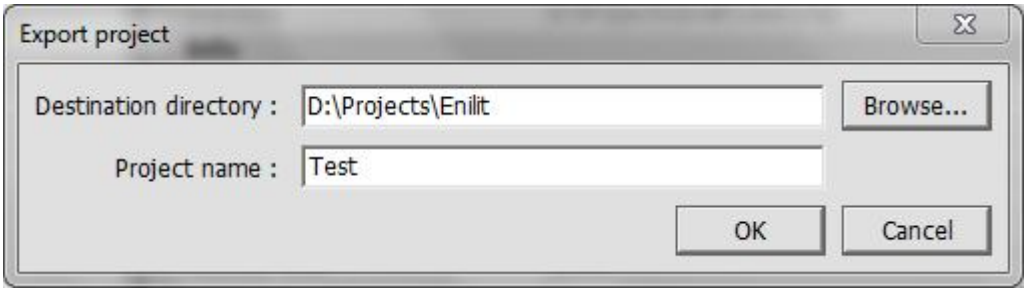


Figure 43. Export project window

Menu item	Description
Destination directory	Where to save exported project
Project name	File name of exported project (in our case Test.ezip)

4.8 Main configuration

Enilit RTU has Windows Embedded Operating System. Parameters regarding network configuration you can configure with default Windows applications without need of any third party applications.

4.8.1 IP addresses

Enilit RTU has by default three Network adapters. Network adapters are independent and each has own MAC address. In that case all Network adapters can have different IP address with a different gateway. You can choose also Static IP address or obtain it by DHCP. To configure a Static IP address for one of three Enilit RTU network adapters, work through the following steps:

1. Launch *Control Panel*

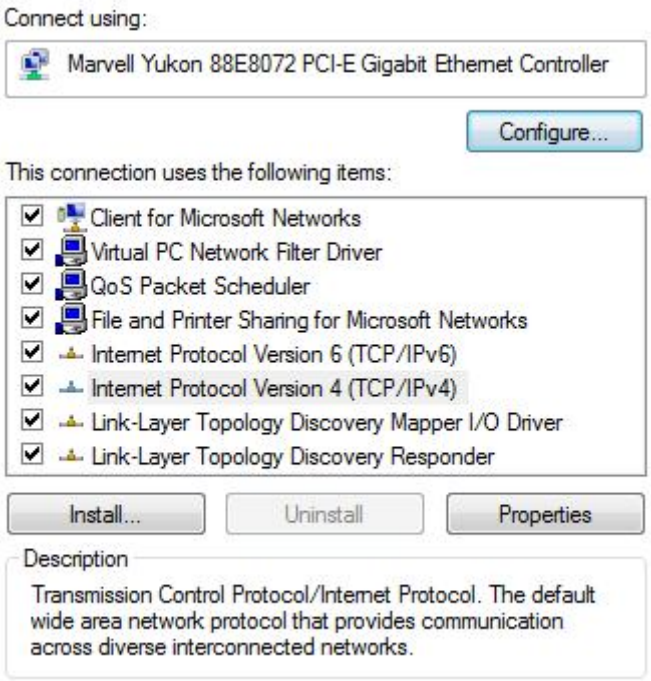
2. Click on *Network and Internet*
3. Click on *Network and Sharing Center*

Network and Sharing Center
View network status and tasks
Connect to a network
View network computers and devices
Add a wireless device to the network

4. On the left pane, click on *Change adapter settings*

5. Right mouse click on the targeted network adapter icon and select *Properties*

6. Select *Internet Protocol Version 4 (TCP/IPv4)* and click on *Properties*.

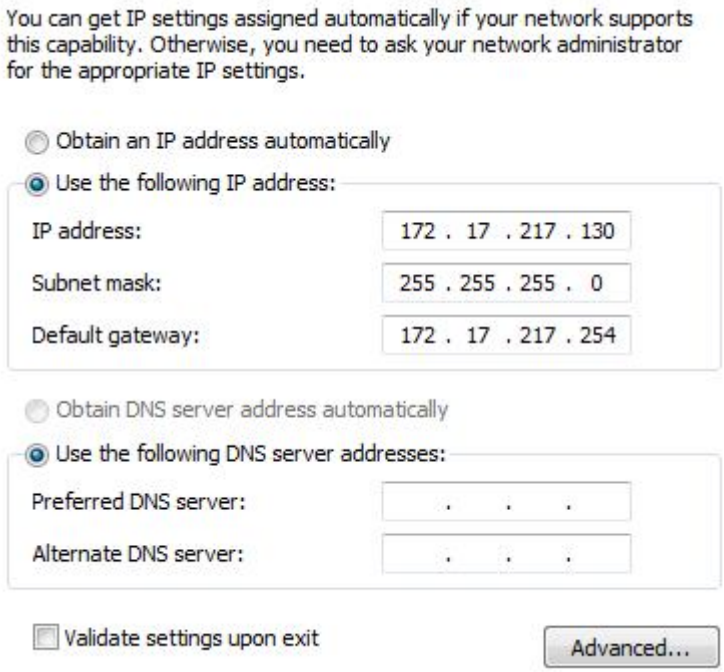

Connect using:
Marvell Yukon 88E8072 PCI-E Gigabit Ethernet Controller
Configure...
This connection uses the following items:
Client for Microsoft Networks
Virtual PC Network Filter Driver
QoS Packet Scheduler
File and Printer Sharing for Microsoft Networks
Internet Protocol Version 6 (TCP/IPv6)
Internet Protocol Version 4 (TCP/IPv4)
Link-Layer Topology Discovery Mapper I/O Driver
Link-Layer Topology Discovery Responder
Install...
Uninstall
Properties
Description
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

7. Select *Use the following IP address* and enter the following IP address and subnet mask:

IP address: 172.17.217.130

Subnet mask: 255.255.255.0

Gateway: 172.17.217.254


You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
172 . 17 . 217 . 130
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
172 . 17 . 217 . 254
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Validate settings upon exit
Advanced...

4.8.2 Remote management

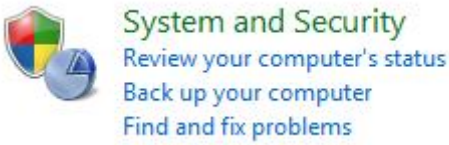
Enilit RTU can be configured and managed not only locally, but also remotely. If you have TCP/IP connection to Enilit RTU, you can connect to it with Remote Desktop Connection application from Windows Operating System. Remotely you can do everything what you can do locally: Enilit RTU Self-control and Diagnosis, change configuration, import/export project, configure Windows OS.

Remote Desktop is not enabled by default. You must specifically enable it to allow remote access to the Enilit RTU. When it is enabled, configured member of the Administrators group can connect to the Enilit RTU.

4.8.2.1 To configure Enilit RTU

To configure remote access, follow these steps:

1. In *Control Panel*, click *System and Security*.



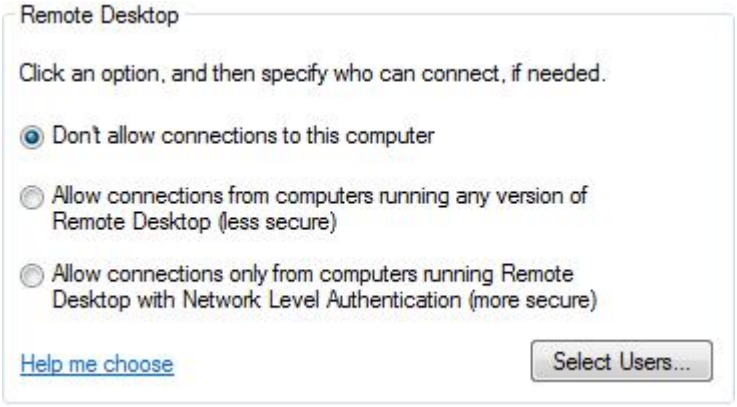
2. Then click *System*.

System
View amount of RAM and processor speed
Check the Windows Experience Index
Allow remote access
See the name of this computer
Device Manager

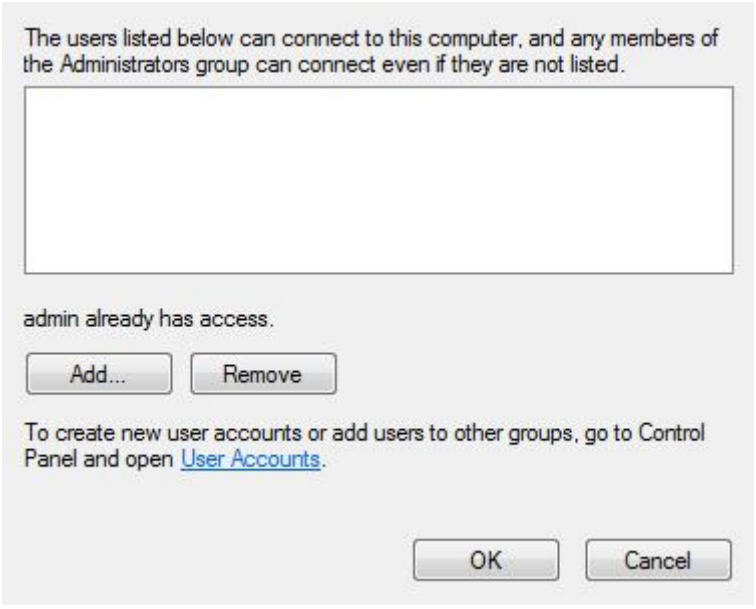
3. On the *System* page, click *Remote Settings* in the left pane. This opens the *System Properties* dialog box to the Remote tab.

4. To enable Remote Desktop, you have two options. You can:

   - Select *Allow Connections from Computers Running Any Version of Remote Desktop* to allow connections from any version of Windows.
   - Select *Allow Connections Only from Computers Running Remote Desktop with Network Level Authentication* to allow connections only from Windows 7 or later computers (and computers with secure network authentication).


Remote Desktop
Click an option, and then specify who can connect, if needed.
Don't allow connections to this computer
Allow connections from computers running any version of Remote Desktop (less secure)
Allow connections only from computers running Remote Desktop with Network Level Authentication (more secure)
Help me choose
Select Users...

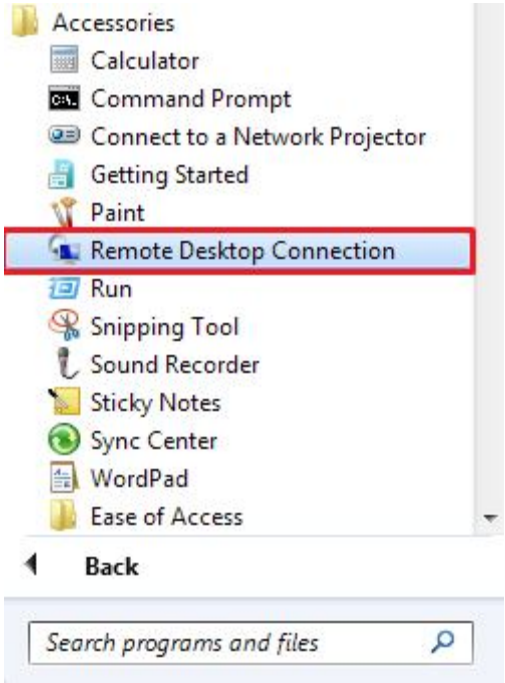
5. Click *Select Users*. This displays the Remote Desktop Users dialog box.
6. To grant Remote Desktop access to a user, click *Add*. This opens the Select Users dialog box. In the Select Users dialog box, click *Locations* to select the computer or domain in which the users you want to work with are located. Type the name of a user you want to work within the Enter the Object Names to Select field, and then click *Check Names*. If matches are found, select the account you want to use and then click *OK*. If no matches are found, update the name you entered and try searching again. Repeat this step as necessary, and then click *OK*.


The users listed below can connect to this computer, and any members of the Administrators group can connect even if they are not listed.
admin already has access.
Add...
Remove
To create new user accounts or add users to other groups, go to Control Panel and open User Accounts.
OK
Cancel

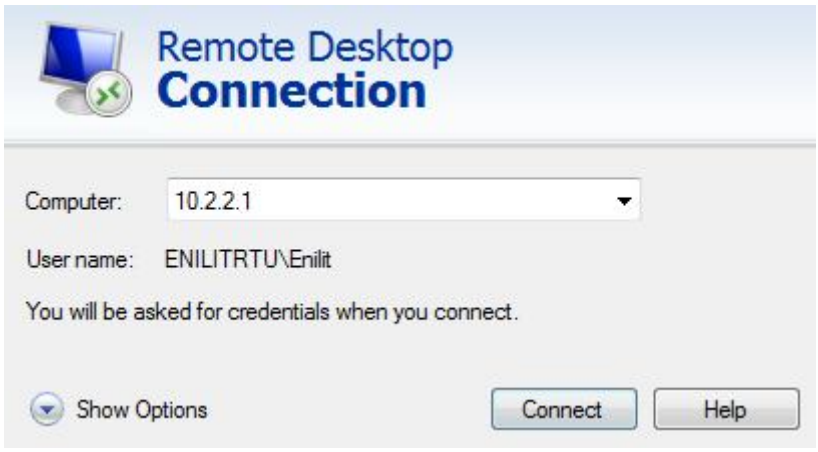
7. Click *OK* twice when you have finished.

4.8.2.2 To connect to Enilit RTU

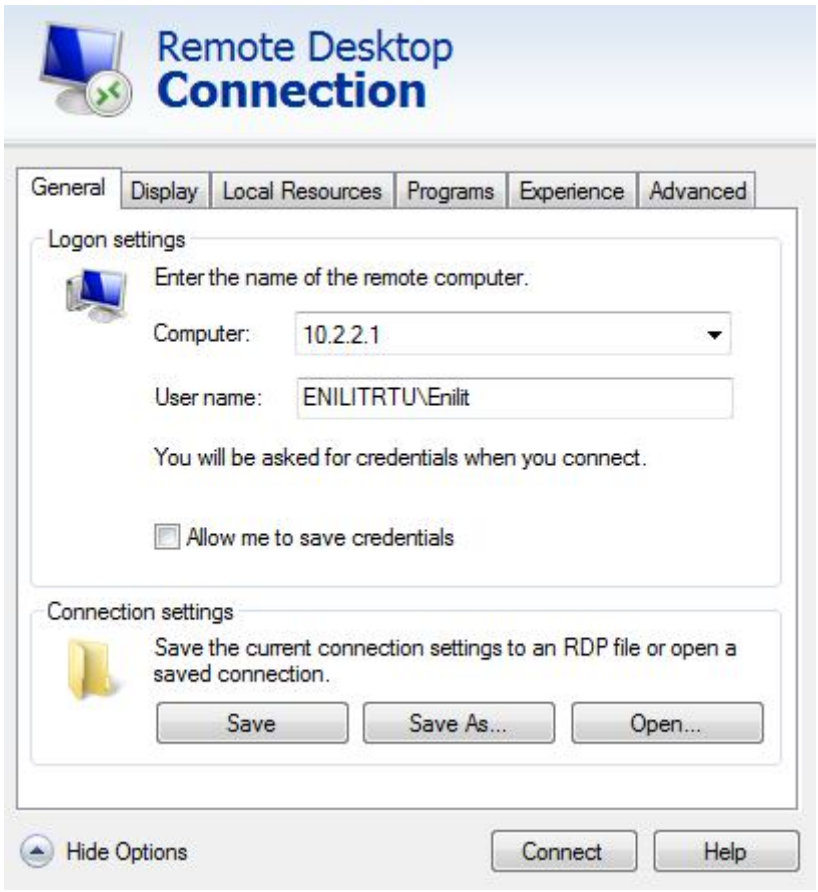
1. Go to *Start>All Programs>Accessories>Remote Desktop Connection*



2. Enter the *Computer Name* or *IP address* of the Enilit RTU you wish to connect to.



3. For more connection options, click on *Show Options*. Here you can save the connection profile, adjust display properties, run specified programs upon connection, adjust connection bandwidth, etc. For more information on specific tabs, click on Help.



4. Click on *Connect.*
5. Enter your log in credentials of a user account on the Enilit RTU that is allowed to do a remote desktop connection.

Default username: EnilitRemote

Default password: Enilit123

4.9 Hardware configuration

The main Hardware configuration window looks like following figure. Left side you will see RTU Card Slots and Hardware Tags trees. In the Card Slots you can configure which module is mounted on the particular slot. Hardware Tags enables you to configure signals, measurements, commands and counters items and connect it to the RTU hardware. In the right pane you will see selected branch items parameters.

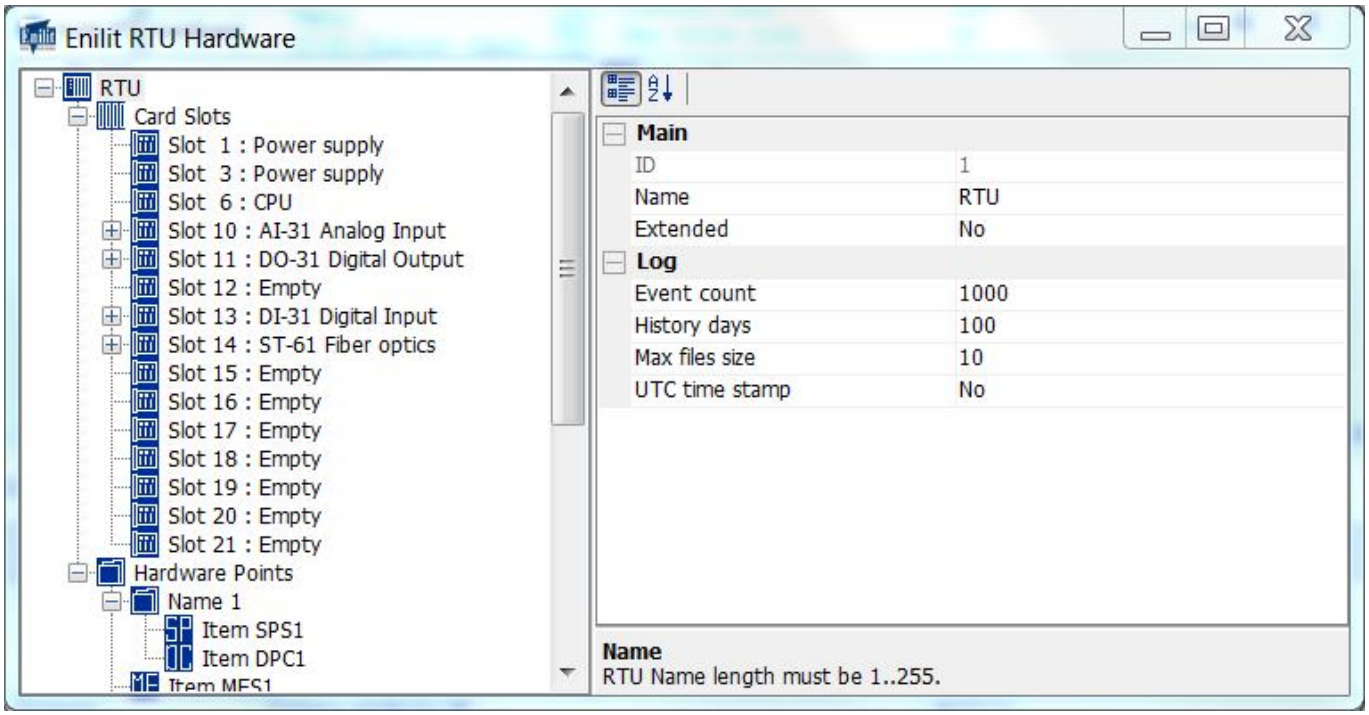


Figure 44. Hardware configuration window

Field name	Description	Default value
ID	RTU unique identification number. Range of Values: 1 … 65535	1
Name	Name of RTU. For example: “Substation 1”	RTU
Extended	Does RTU contain extension rack.	No
Event count	Number of event to keep in one file. Range of Values: 100 … 100000	1000
History days	Number of days to keep files in history. Range of Values: 1 … 1000	100
Max files size	Maximum log files size. Range of Values: 1 … 100 Mb	10
UTC time stamp	Allows to choose the time stamp used in log files.	No

	Values: No, Yes	

4.9.1 Power supply

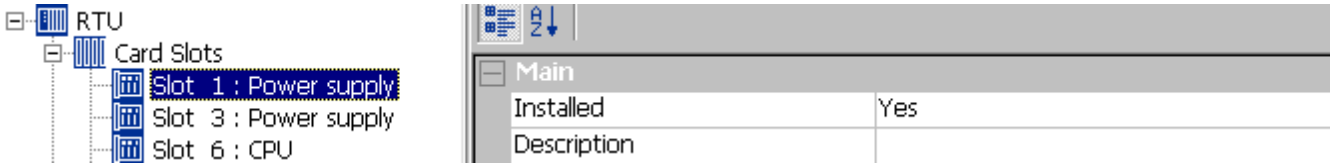


Figure 45. Power supply parameters

Field name	Description	Default value
Installed	Power supply is installed in slot	No
Description	Free user description or comment	

4.9.2 CPU

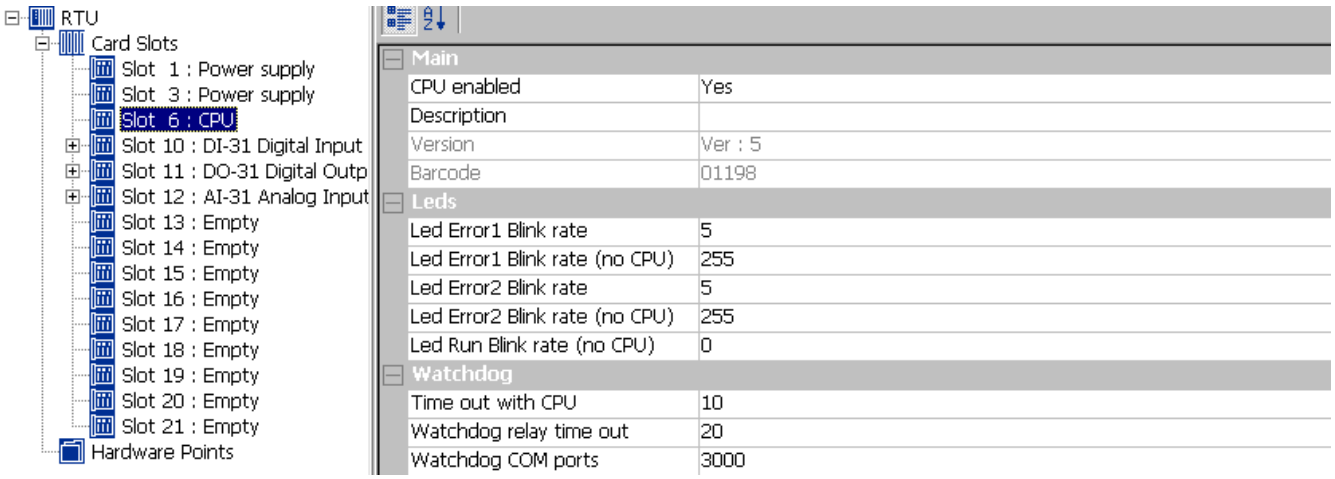


Figure 46. CPU parameters

Field name	Description	Default value
CPU enabled	CPU enabled on system startup.	Yes
Description	Free user description or comments	
Version	Hardware and software version of card	
Barcode	Barcode of installed card.	
Led Error1 Blink rate	Led Error1 blink rate in 100 ms Range of Values: 1 … 254	5

Led Error1 Blink rate (no CPU)	Led Error1 blink rate in 100 ms, when there is no communication with CPU Range of Values: 0 … 255 0 – means always OFF	255
Led Error2 Blink rate	Led Error2 blink rate in 100 ms Range of Values: 1 … 254	5
Led Error2 Blink rate (no CPU)	Led Error2 blink rate in 100 ms, when there is no communication with CPU Range of Values: 0 … 255 0 – means always OFF	255
Led Run Blink rate (no CPU)	Led Run blink rate in 100 ms, when there is no communication with CPU Range of Values: 0 … 255 0 – means always OFF	0
Time out with CPU	Communication time out with CPU in 100 ms. Time when no activity got from Main CPU. Range of Values: 10 … 255	10
Watchdog relay time out	Watchdog relay time out in seconds. Time when no activity got from Main CPU (Operating system or Main program not running or loading). Range of Values: 1 … 255	20
Watchdog COM ports	COM communication ports will be disabled after set time of milliseconds. Range of Values: 0 … 65535 0 – communication ports will never be disabled.	3000

4.9.3 Card Slots

Following figure shows Card Slots tree. Here you can assign hardware modules to the particular slot. The type of the module is written on the top of the module front panel.

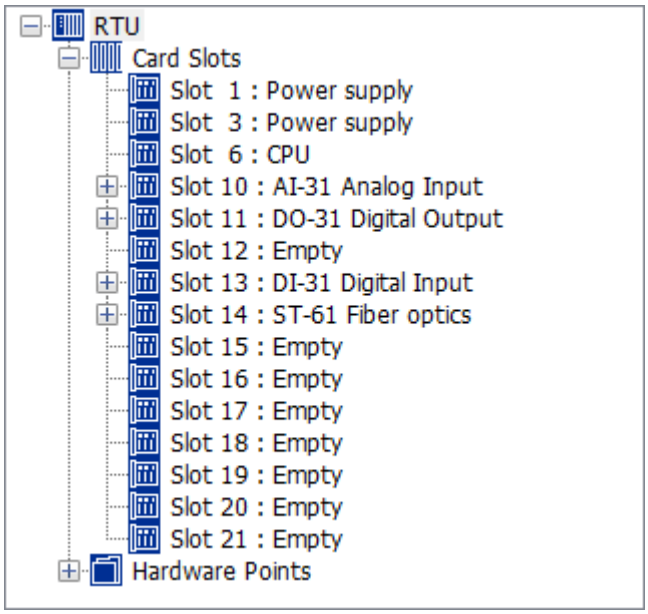

RTU
Card Slots
Slot 1 : Power supply
Slot 3 : Power supply
Slot 6 : CPU
Slot 10 : AI-31 Analog Input
Slot 11 : DO-31 Digital Output
Slot 12 : Empty
Slot 13 : DI-31 Digital Input
Slot 14 : ST-61 Fiber optics
Slot 15 : Empty
Slot 16 : Empty
Slot 17 : Empty
Slot 18 : Empty
Slot 19 : Empty
Slot 20 : Empty
Slot 21 : Empty
Hardware Points

Figure 47. RTU Slots tree

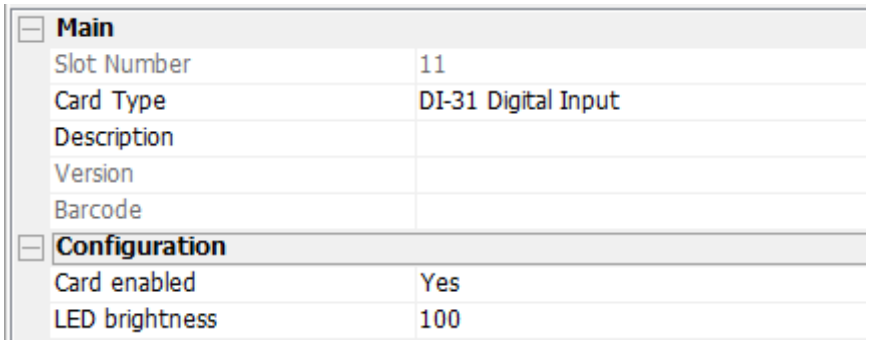


Figure 48. Slot parameters pane

Field name	Description	Default value
Slot number	Number of RTU slot. Only for internal use. For example: 10 … 21	Depends on slot number.
Card enabled	Card is enabled	Yes
Card Type	Choose type of module. Values: DI-31 Digital Input, DO-31 Digital Output, AI-31 Analog Input, ST-61 Fiber optics	Empty
Description	Description of card	
Version	Hardware and software version of card	
Barcode	Barcode of installed card.	

LED brightness	Enables to configure LED brightness on particular module. Range of Values: 0 … 100 %	100

4.9.4 Hardware items parameters

4.9.4.1 Digital input

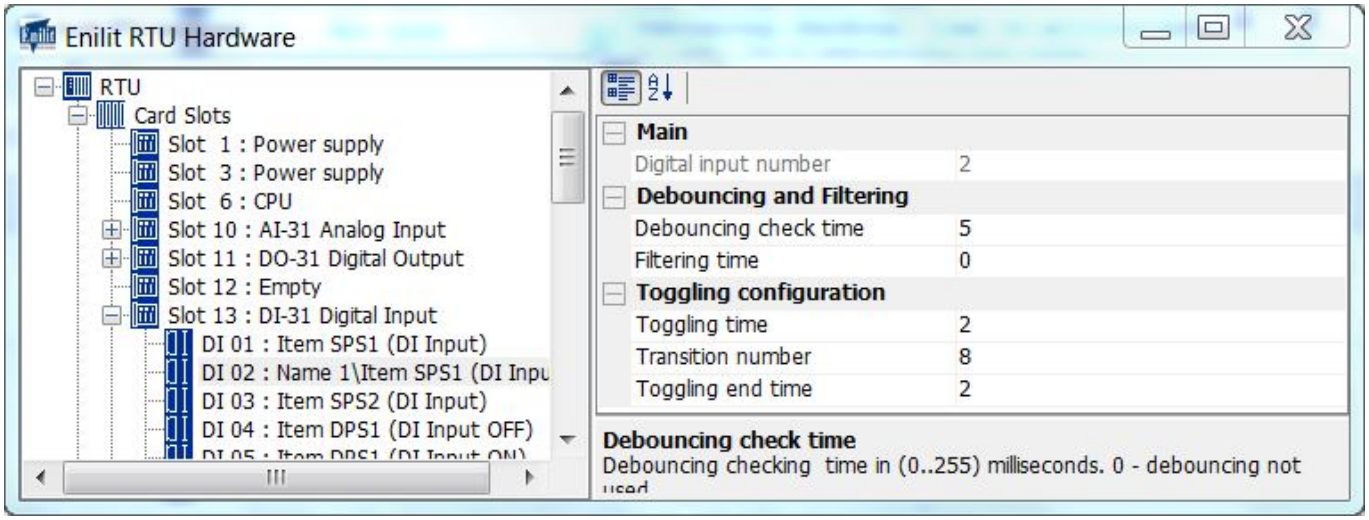

Enilit RTU Hardware
RTU
Card Slots
Slot 1 : Power supply
Slot 3 : Power supply
Slot 6 : CPU
Slot 10 : AI-31 Analog Input
Slot 11 : DO-31 Digital Output
Slot 12 : Empty
Slot 13 : DI-31 Digital Input
DI 01 : Item SPS1 (DI Input)
DI 02 : Name 1\Item SPS1 (DI Inpu
DI 03 : Item SPS2 (DI Input)
DI 04 : Item DPS1 (DI Input OFF)
Main
Digital input number 2
Debouncing and Filtering
Debouncing check time 5
Filtering time 0
Toggling configuration
Toggling time 2
Transition number 8
Toggling end time 2
Debouncing check time
Debouncing checking time in (0..255) milliseconds. 0 - debouncing not

Figure 49. Digital Input parameters

Field name	Description	Default value
Digital input number	Number of digital input. Only for internal use. For example: 1 … 24	Depends on digital input
Debouncing check time	Debouncing checking time in milliseconds. If the value is 0, then debouncing filter is not used. Range of Values: 0 … 255 ms	5
Filtering time	Filter checking time in milliseconds. If value is 0, then filtering is not used. Range of Values: 0 … 255 ms	1
Toggling end time	Time delay after which no changes are detecting. Range of Values: 0 … 60 s	1
Toggling time	Toggling checking time. If value is 0, then toggling is not used. Range of Values: 0 … 60 s	1
Transition number	Transition count in toggling time to set quality of binary input to Not Topical. Range of Values: 2 … 60	8

4.9.4.2 Digital output

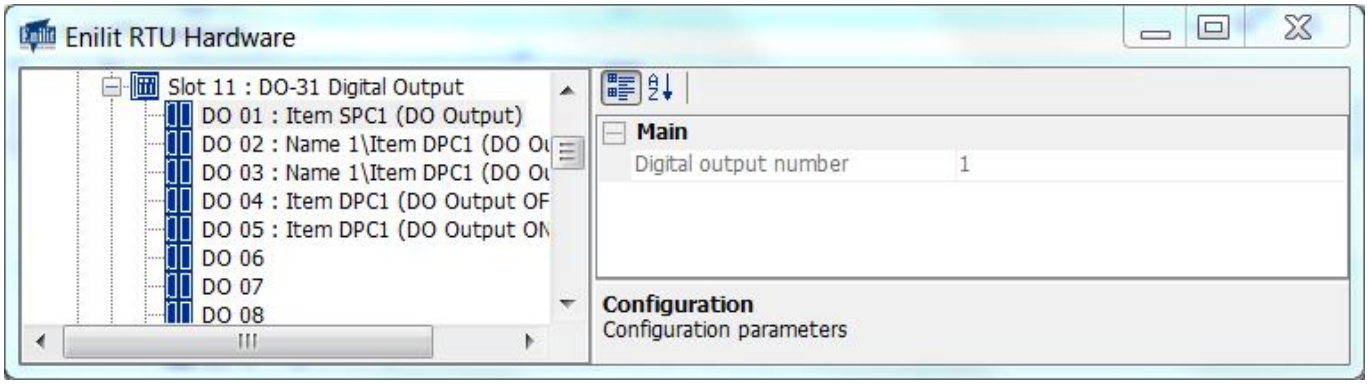

Enilit RTU Hardware
Slot 11 : DO-31 Digital Output
DO 01 : Item SPC1 (DO Output)
DO 02 : Name 1\Item DPC1 (DO Ou
DO 03 : Name 1\Item DPC1 (DO Ou
DO 04 : Item DPC1 (DO Output OF
DO 05 : Item DPC1 (DO Output ON
DO 06
DO 07
DO 08
Main
Digital output number
1
Configuration
Configuration parameters

Figure 50. Digital outputs parameters

Field name	Description	Default value
Digital output number	Number of digital output. Only for internal use. For example: 1 … 24	Depends on digital output

4.9.4.3 Analog input

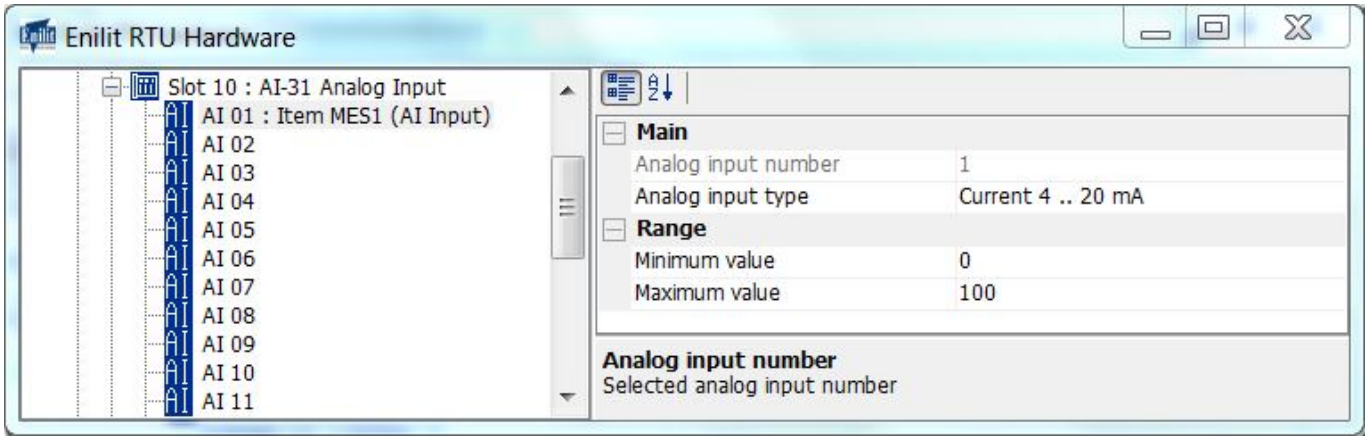


Figure 51. Analog input parameters

Field name	Description	Default value
Analog input number	Number of analog input. Only for internal use. For example: 1 … 12	Depends on analog input
Analog input type	Configuration allows you to set the analog input type to the measuring range. Range of Values: Current 0 … 1 mA Current -1 … 1 mA Current 0 … 5 mA Current -5 … 5 mA	Current 4 … 20 mA

	Current 0 … 10 mA Current -10 … 10 mA Current 4 … 20 mA Current 0 … 20 mA Current -20 … 20 mA Voltage -10 … 10 V Voltage -5 … 5 V Voltage -2,5 … 2,5 V Voltage -1,25 … 1,25 V	
Maximum value	Here the maximum raw value of analog input for the conversation to normalized measured value. Range of Values: -32767 … 32767	100
Minimum value	Here the minimum raw value of analog input for the conversation to normalized measured value. Range of Values: -32767 … 32767	0

4.9.4.4 Fiber optics

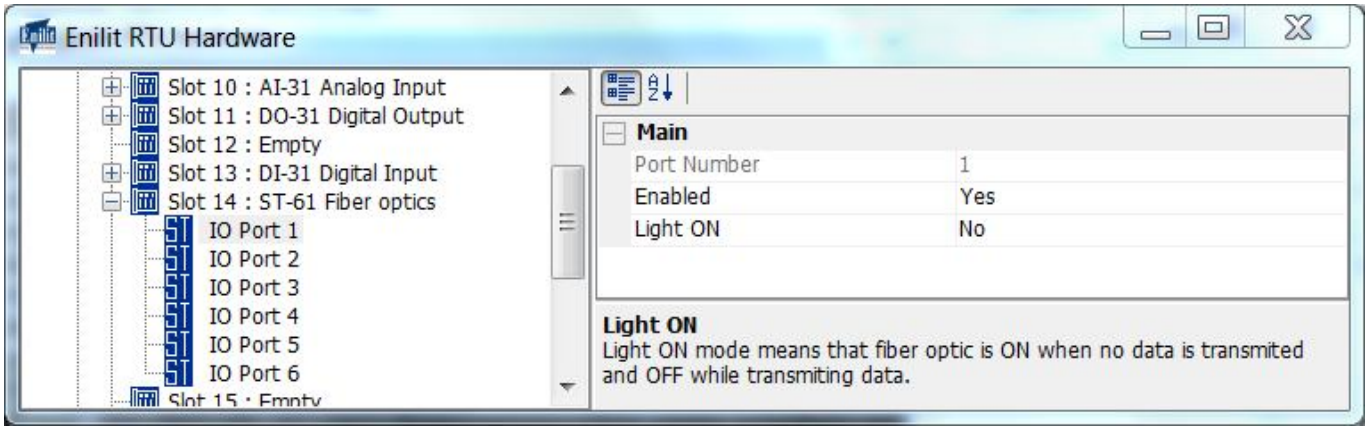

Enilit RTU Hardware
Slot 10 : AI-31 Analog Input
Slot 11 : DO-31 Digital Output
Slot 12 : Empty
Slot 13 : DI-31 Digital Input
Slot 14 : ST-61 Fiber optics
IO Port 1
IO Port 2
IO Port 3
IO Port 4
IO Port 5
IO Port 6
Slot 15 : Empty
Main
Port Number 1
Enabled Yes
Light ON No
Light ON
Light ON mode means that fiber optic is ON when no data is transmited and OFF while transmiting data.

Figure 52. Fiber optics parameters

Field name	Description	Default value
Enabled	Turn on or off fiber optic port. Values: No, Yes	Yes
Light ON	Light on or off fiber optic port. Values: No, Yes	No
Port Nr	Physical port number from the top. Range of Values: 1 … 6	Depends on IO Port number

4.9.5 Hardware Tags

Here you create Hardware tags, which you connect to hardware digital inputs, analog inputs, and command outputs.

The following figure shows popup menu of hardware tags. With it you can create Hardware Tags tree. After that you can create tags like single point status, double point status, multi point status, single commands, double commands, multi point commands, measurements, and counter single, counter doubles.

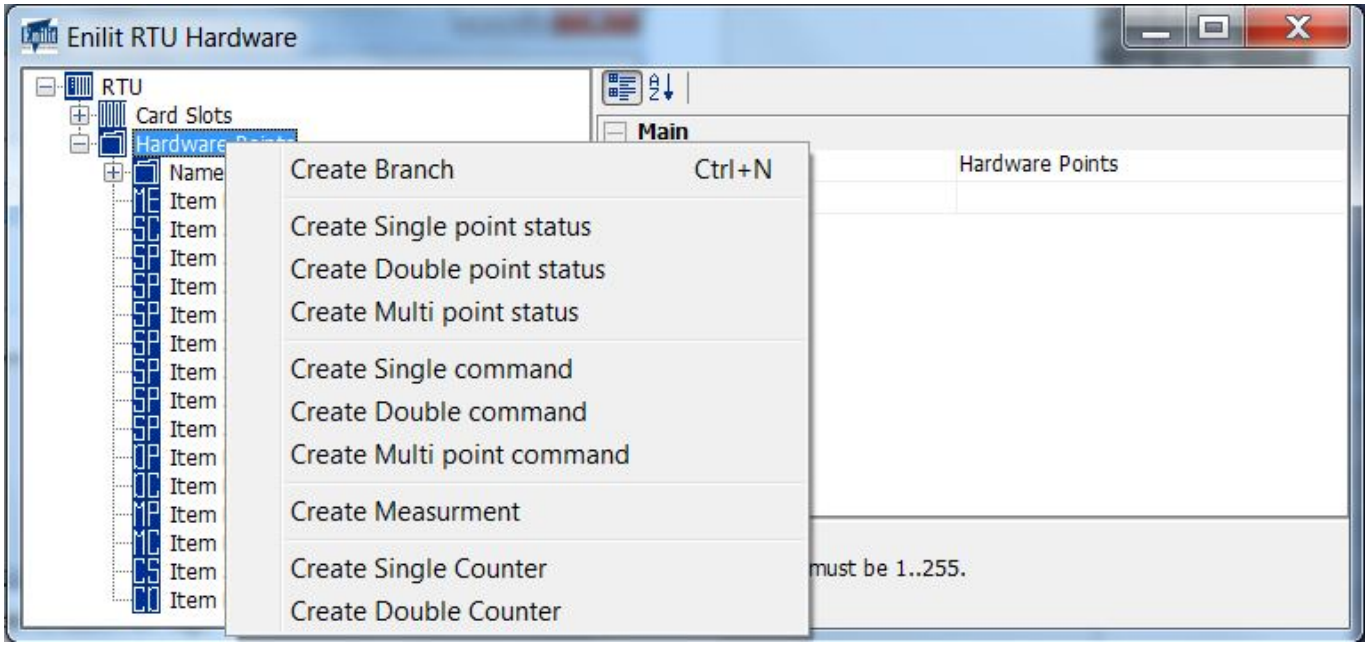


Figure 53. Popup menu of hardware tags.

4.9.5.1 Single point parameters

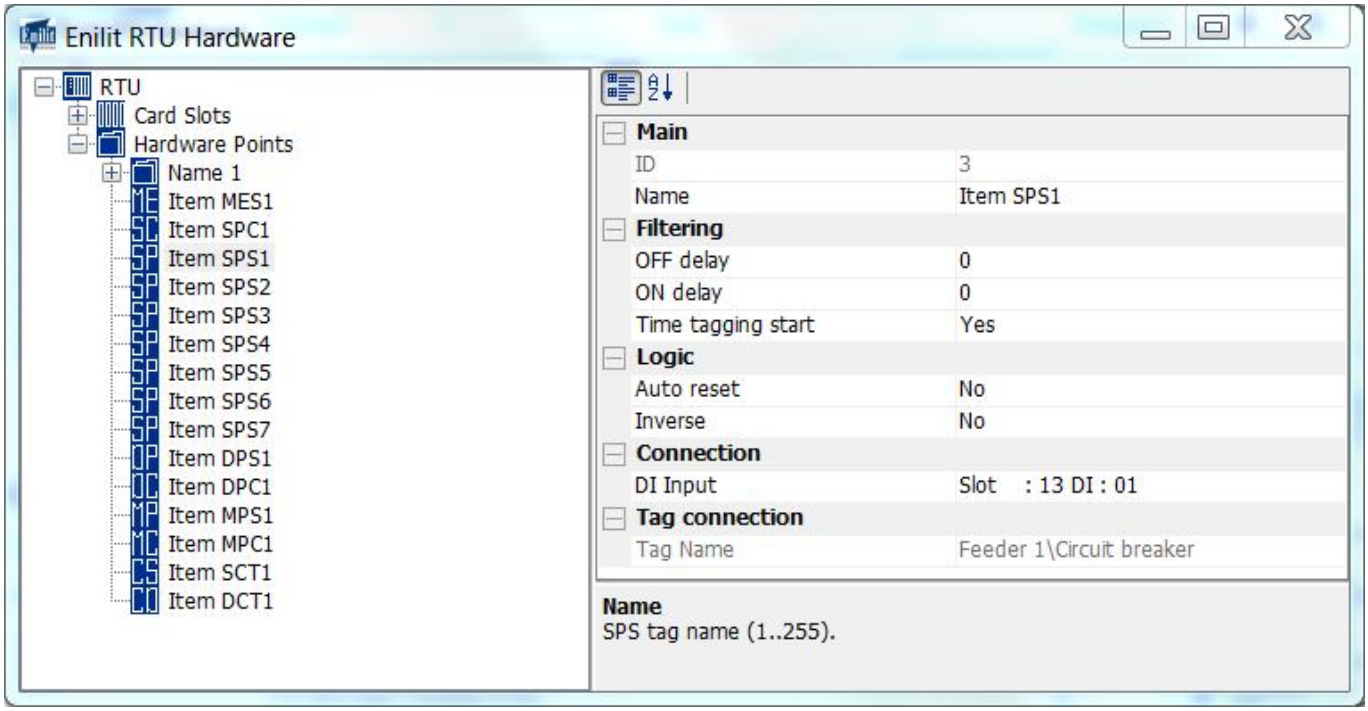


Figure 54. Hardware Tags tree and single point signal parameters

Field name	Description	Default value
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “IED fault” Length: 1 … 255	Item SPS1
DI input	Allows connecting hardware tag to binary input. For example: Slot : 13 DI : 01	Not set
OFF delay	Delay on stable state after which the hardware tag is set to OFF. (100 ms) Range of Values: 0 … 1000	0
ON delay	Delay on stable state after which the hardware tag is set to ON. (100 ms) Range of Values: 0 … 1000	0
Time tagging start	Type of tag timestamp. Event can be with start or end of filtering timestamp. Values: Yes, No	Yes
Auto reset	Auto reset hardware tag from ON to OFF. Values: No, Yes	No
Inverse	Invert of hardware tag. Values: No, Yes	No
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.2 Double point parameters

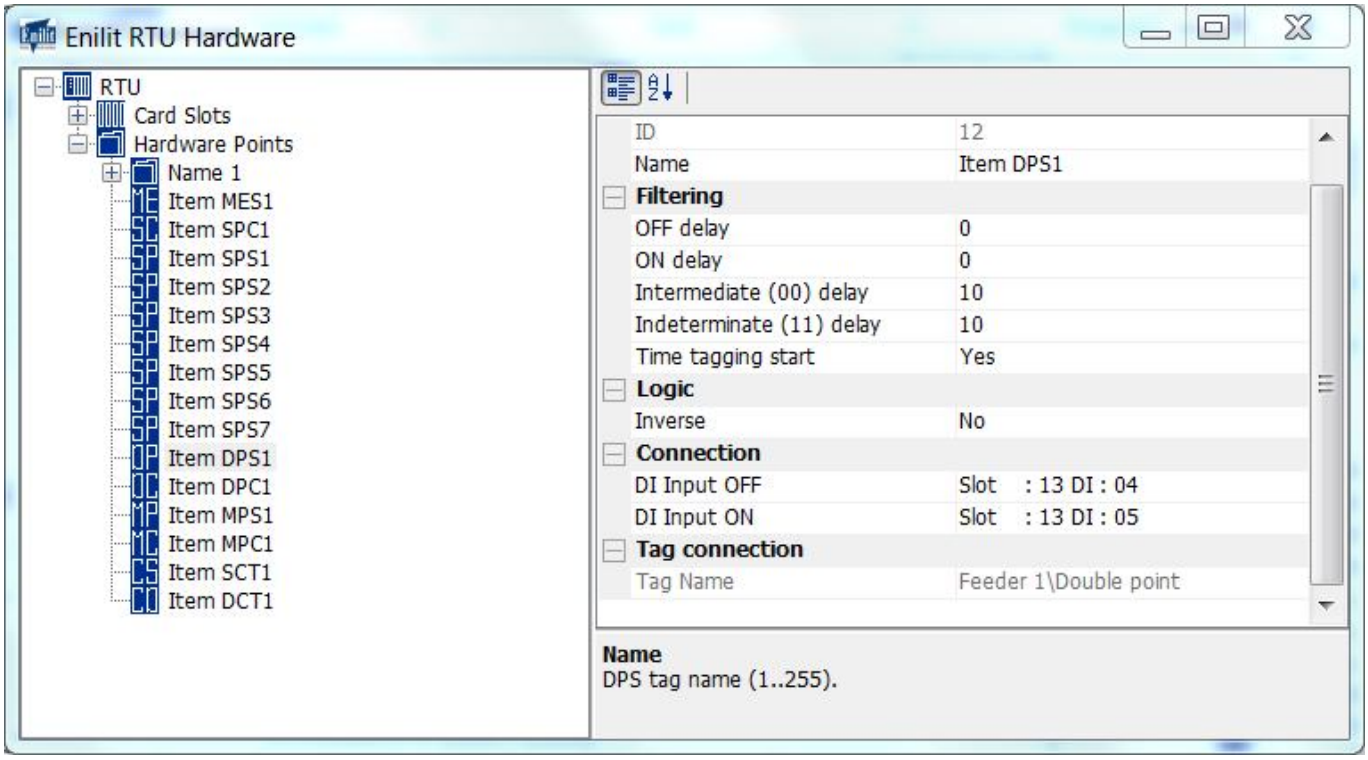


Figure 55. Hardware Tags tree and double point signal parameters

Field name	Description	Default value
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “Item DPS1” Length: 1 … 255	Item DPS1
DI input OFF	Allows connecting hardware tag to binary input. For example: Slot : 13 DI : 04	Not set
DI input ON	Allows connecting hardware tag to binary input. For example: Slot : 13 DI : 05	Not set
Intermediate (00) delay	Delay on stable state after which the hardware tag is set to Jammed (both inputs are not active). (100 ms) Range of Values: 0 … 1000	0
OFF delay	Delay on stable state after which the hardware tag is set to OFF. (100 ms) Range of Values: 0 … 1000	0

ON delay	Delay on stable state after which the hardware tag is set to ON. (100 ms) Range of Values: 0 … 1000	0
Indeterminate (11) delay	Delay on stable state after which the hardware tag is set to Undefined (both inputs are active). (100 ms) Range of Values: 0 … 1000	0
Time tagging start	Type of tag timestamp. Event can be with start or end of filtering timestamp. Range of Values: Yes, No	Yes
Inverse	Invert of hardware tag. Range of Values: Yes, No	No
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.3 Multipoint status

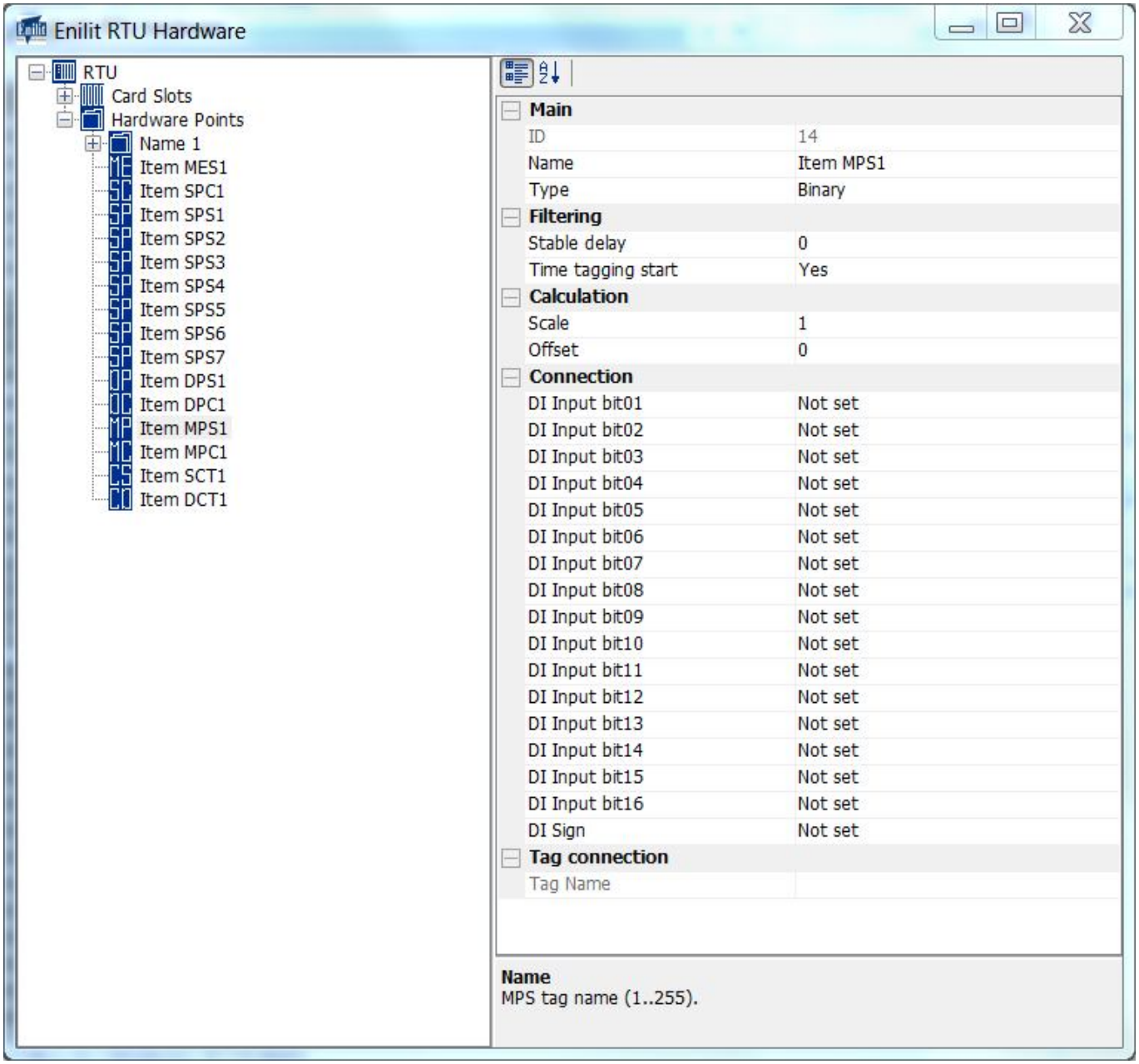


Figure 56. Hardware Tags tree and double multipoint status parameters

Field name	Description	Default value
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “Item MPS1” Length: 1 … 255	Item MPS1
Type	Select type of multipoint status.	Binary

	Range of Values: Binary, BCD, 1 from N bits, Gray	
DI Input bit01 … DI Input bit16	Allows connecting one of multipoint status item to binary input. For example: Slot : 13 DI : 04	Not set
DI Sign	Allows connecting binary input used for multipoint status sign. For example: Slot : 13 DI : 04	Not set
Stable delay	Delay on stable state before changing tags value in 100 ms. Range of Values: 0 … 1000	0
Time tagging start	Type of tag timestamp. Event can be with start or end of filtering timestamp. Range of Values: Yes, No	Yes
Offset	Offset value for conversion. Range of Values: 0 … 100	0
Scale	Scale value for conversion. Range of Values: 0 … 100	1
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.4 Single command parameters

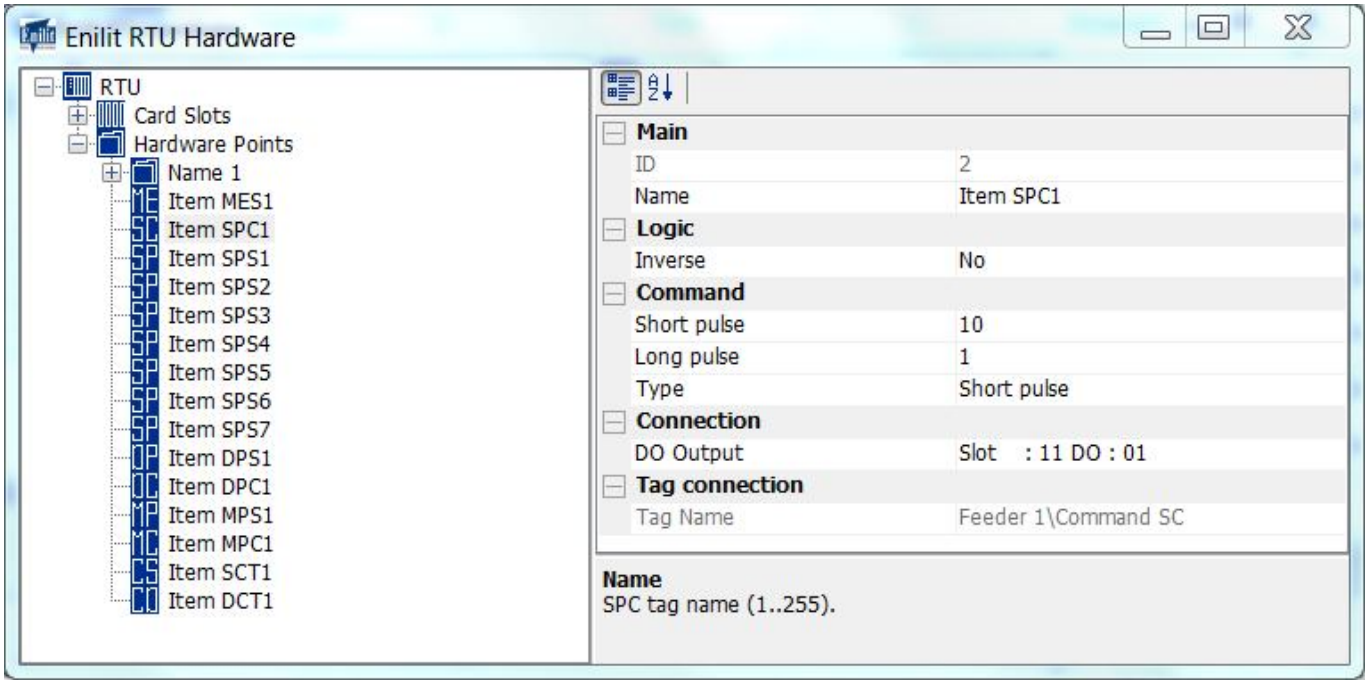


Figure 57. Hardware Tags tree and single command parameters

Field name	Description	Default value
Long pulse	Long pulse length in seconds. Range of Values: 1 … 600	1
Short pulse	Short pulse length in 10 milliseconds. Range of Values: 10 … 6000	10
Type	If command got with unknown or undefined type it will be overridden with this type of pulse. Range of Values: Pulse short, Pulse long, Persistent	Pulse short
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “Item SPC1” Length: 1 … 255	Item SPC1
DO output	Allows connecting hardware tag to digital output. For example: Slot : 11 DO : 01	Not set

Inverse	Invert of hardware tag. Range of Values: Yes, No	No
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.5 Double command parameters

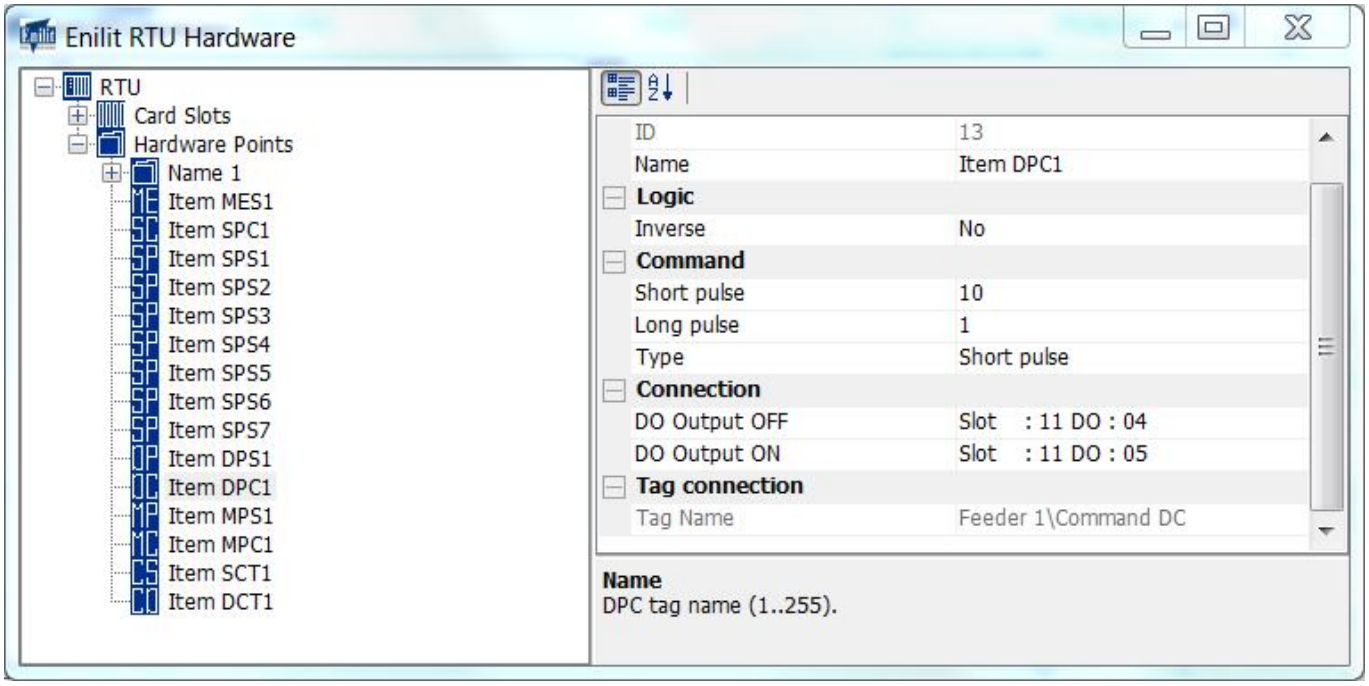


Figure 58. Hardware Tags tree and double command parameters

Field name	Description	Default value
Long pulse	Long pulse length in seconds. Range of Values: 1 … 600	1
Short pulse	Short pulse length in 10 milliseconds. Range of Values: 10 … 6000	10
Type	If command got with unknown or undefined type it will be overridden with this type of pulse. Range of Values: Pulse short, Pulse long, Persistent	Pulse short
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag

Name	Hardware tag name. For example: “Item DPC1” Length: 1 … 255	Item DPC1
DO output OFF	Allows connecting hardware tag to digital output. For example: Slot : 11 DO : 04	Not set
DO output ON	Allows connecting hardware tag to digital output. For example: Slot : 11 DO : 05	Not set
Inverse	Invert of hardware tag. Range of Values: Yes, No	No
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.6 Multipoint command

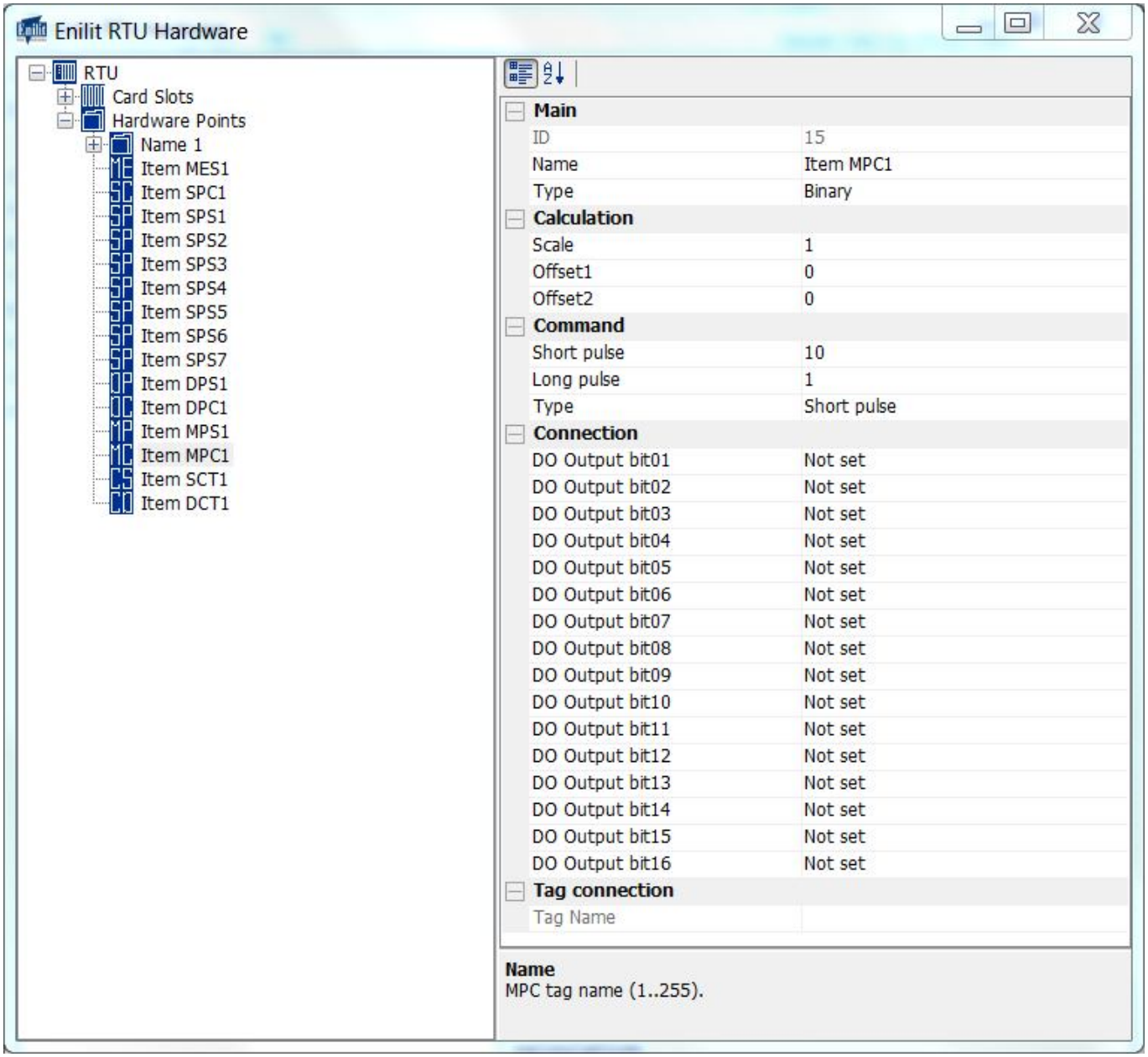


Figure 59. Hardware Tags tree and multipoint command parameters

Field name	Description	Default value
Long pulse	Long pulse length in seconds. Range of Values: 1 … 600	1
Short pulse	Short pulse length in 10 milliseconds. Range of Values: 10 … 6000	10
Type	If command got with unknown or undefined type it will be overridden with this type of pulse. Range of Values: Pulse short,	Pulse short

	Pulse long, Persistent	
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “Item MPC1” Length: 1 … 255	Item MPC1
Type	Select type of multipoint command. Range of Values: Binary, BCD, 1 from N bits, Gray	Binary
DO Output bit01 … DO Output bit16	Allows connecting one of multipoint command item to binary output. For example: Slot : 13 DO : 04	Not set
Offset1	Offset value for conversion. Range of Values: 0 … 100	0
Offset2	Offset value for conversion. Range of Values: 0 … 100	0
Scale	Scale value for conversion. Range of Values: 0 … 100	1
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.7 Measurement parameters

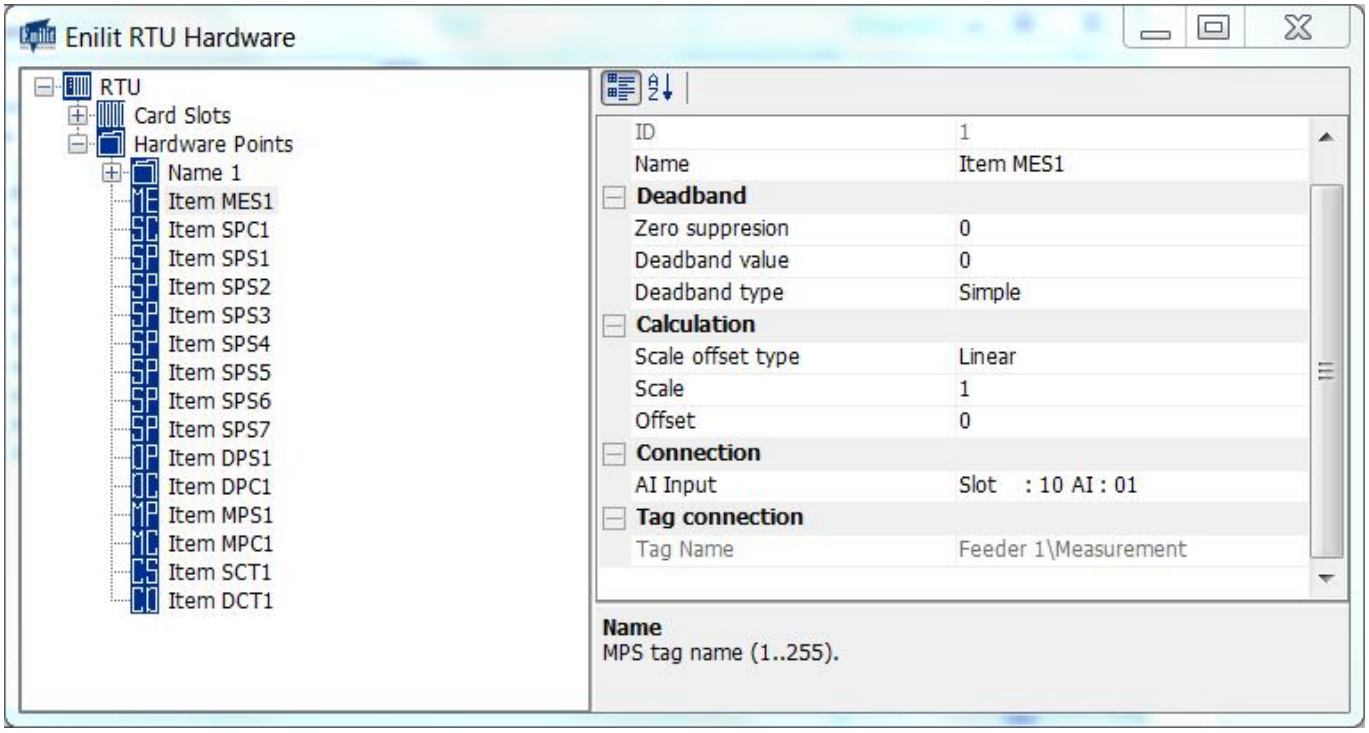


Figure 60. Hardware Tags tree and measurement parameters

Field name	Description	Default value
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “Voltage U1” Length: 1 … 255	Item MV1
AI input	Allows connecting hardware tag to analog input. For example: Slot : 15 AI : 01	Not set
Dead band type	Type of measurement dead band. Range of Values: Simple, Integrated	Simple
Dead band value	Change of measurement is sent if the change is more than this dead band value. If the value is 0, then all changes are sent. Range of Values: 0 … 32767	0
Zero suppression	Set value to zero if it reaches below this value.	0

	Range of Values: 0 … 32767	
Offset	Offset value for conversion. Range of Values: 0 … 100	0
Scale	Scale value for conversion. Range of Values: 0 … 100	1
Scale offset type	Type of conversion. Range of Values: Linear, Quadratic	Linear
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.8 Single counter parameters

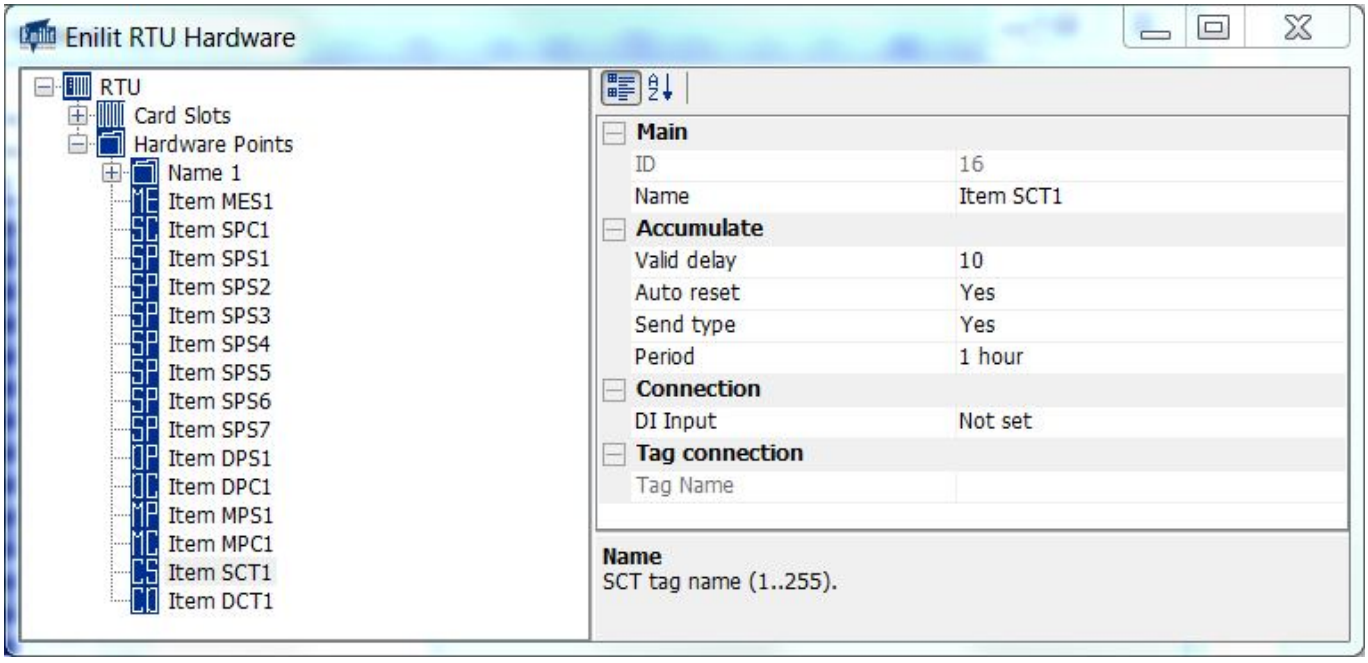


Figure 61. Hardware Tags tree and single counter parameters

Field name	Description	Default value
Auto reset	Automatically reset counter value after accumulation period. Values: Yes, No	Yes
Period	Period for which accumulation should be proceeded. Range of values: 1 minute … 12 hours	1 hour
Send type	Yes – counter value is sent only on period end.	Yes

	No – counter value is sent on period end and every second. Values: Yes, No	
Valid delay	Stable ON delay before increasing tags value. Range of Values: 0 … 1000 ms	10
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “Counter C1” Length: 1 … 255	Item SCT1
DI input	Allows connecting hardware tag to digital input. For example: Slot : 12DI : 01	Not set
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.9.5.9 Double counter parameters

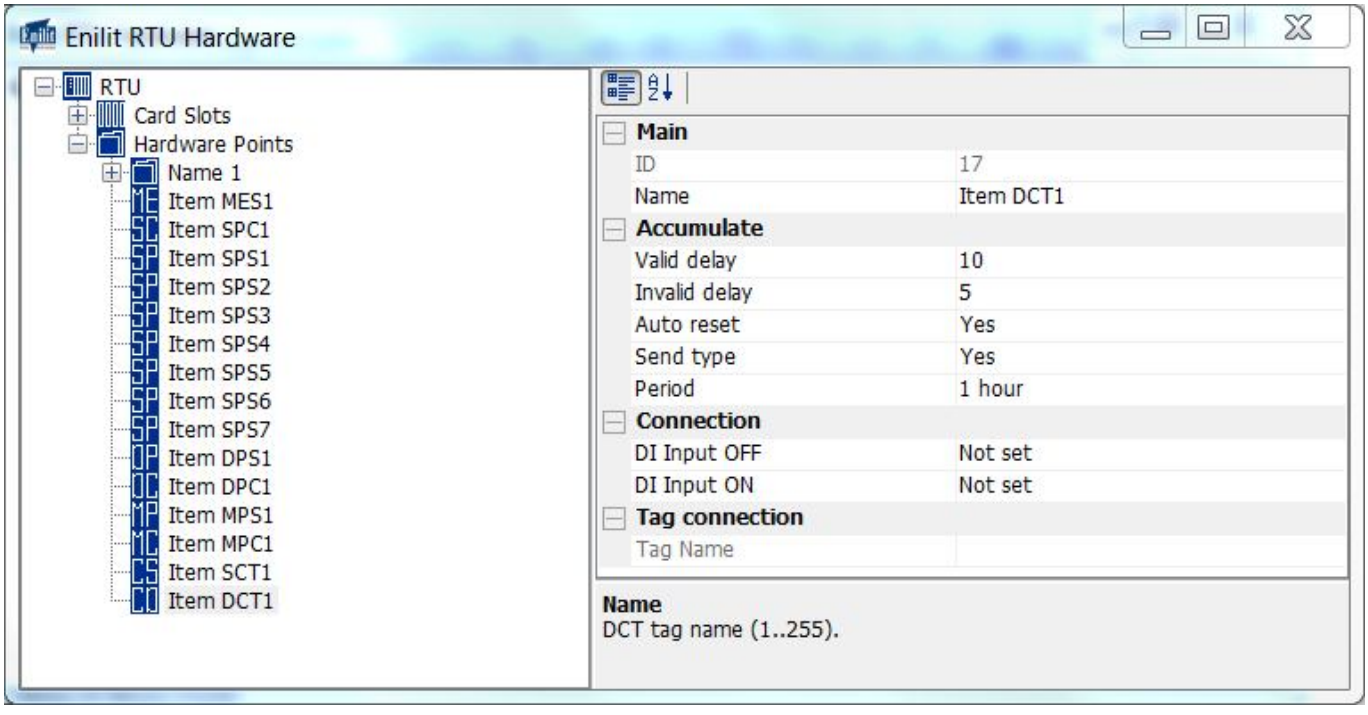


Figure 62. Hardware Tags tree and double counter parameters

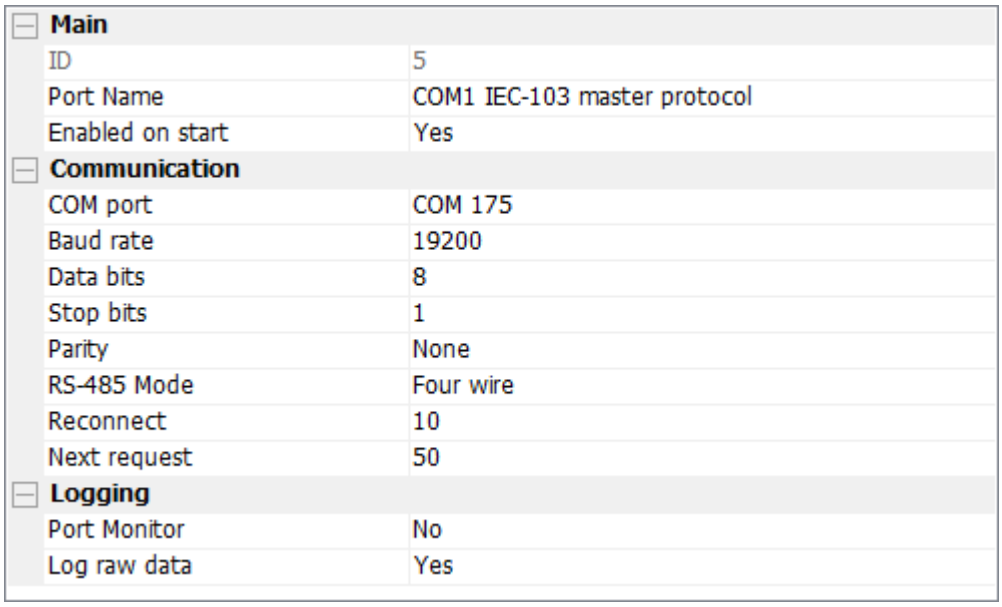
Field name	Description	Default value
Auto reset	Automatically reset counter value after accumulation period.	Yes

	Values: Yes, No	
Invalid delay	Delay after which binary inputs not went to normal state. Tags value is not increased. Range of Values: 0 … 1000 ms	5
Period	Period for which accumulation should be proceeded. Range of values: 1 minute … 12 hours	1 hour
Send type	Yes – counter value is sent only on period end. No – counter value is sent on period end and every second. Values: Yes, No	Yes
Valid delay	Stable ON delay before increasing tags value. Range of Values: 0 … 1000 ms	10
ID	Identification number of hardware tag. Only for internal use. Range of Values: 1 … 65535	Depends on tag
Name	Hardware tag name. For example: “Counter C1” Length: 1 … 255	Item DCT1
DI input OFF	Allows connecting hardware tag to digital input. DI input used for OFF counting. For example: Slot : 12DI : 01	Not set
DI input ON	Allows connecting hardware tag to digital input. DI input used for ON counting. For example: Slot : 12DI : 01	Not set
Tag Name	Hardware tag connection to *Tag manager*. *Tag manager* tag name.	-

4.10 Master protocols

4.10.1 IEC 60870-5-103 configuration

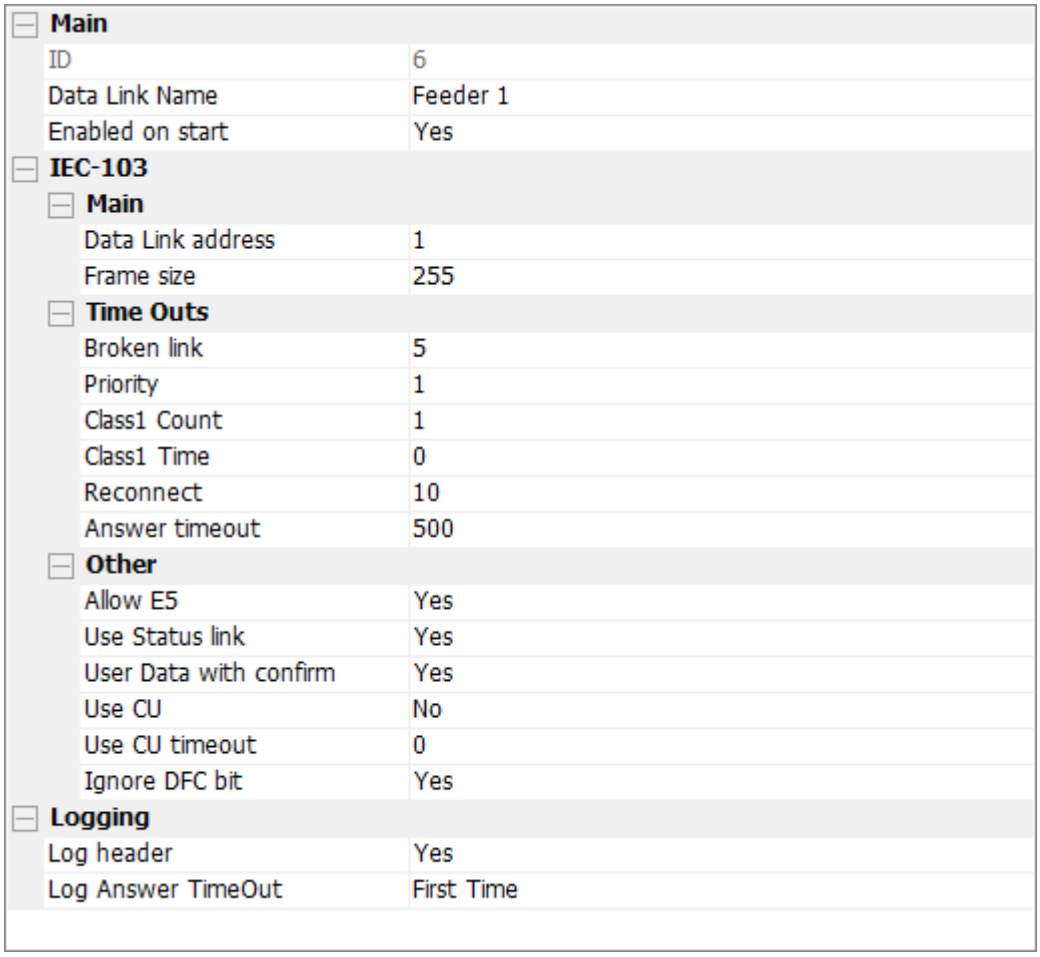
4.10.1.1 Communication port parameters



Field name	Description	Default value
ID	For internal use.	
Port name	Name of the port and protocol. For example: “COM1 IEC103 master protocol”	New IEC-103 master protocol
Enabled on start	Port enabled on system startup. Values: No, Yes	No
Com port	Communication port number. Range of values: 1 … 255	Not assigned
Baud rate	Serial port baud rate. Range of values: 110 … 921600	19200
Data bits	Serial port data bits. Values: 7,8 bits	8
Stop bits	Serial port stop bits. Values: 1, 1.5, 2 bits	1
Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	None

RS-485 Mode	If used two wires mirrored data check should be used. If serial port is RS-232, parameter is not important. Range of values: Four wires, Two wires	Four wire
Reconnect	How often try to reconnect to communication port if there was error. Range of values: 1 … 600 seconds	10
Next request	Wait time before sending next request Range of values: 0 … 1000 ms	50
Port Monitor	Show port monitor on system startup. Values: No, Yes	No
Log raw data	Log raw communication data. Values: No, Yes	Yes

4.10.1.2 Data link layer parameters

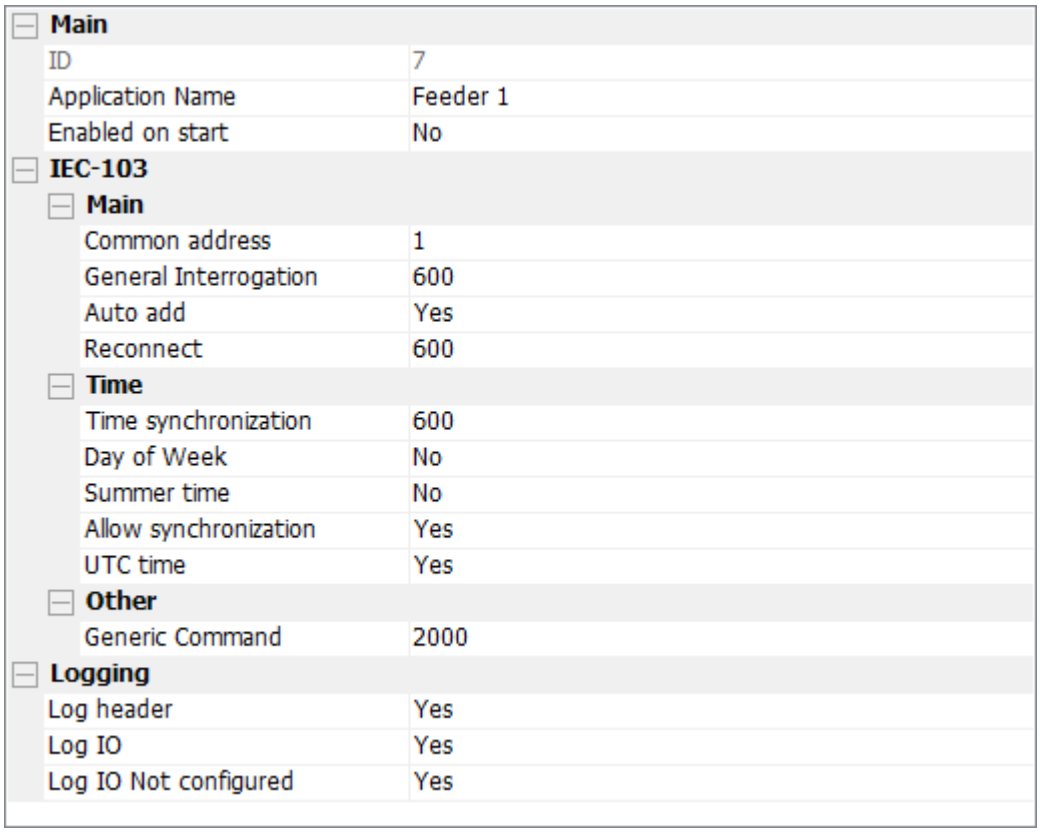


Field name	Description	Default value

ID	For internal use.	
Data link name	Data link layer name. For example: “Feeder 1”.	New Data Link layer
Enabled on start	Enables or disables data link on start. Values: No, Yes	Yes
Data link address	Data link address Range of values: 1 … 254	1
Frame size	Maximum frame length Range of values: 50 … 255 bytes	255
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 10	5
Priority	Request data every cycle. Range of values: 1 … 255	1
Class1 Count	How many times request the same data link layer, if there is Class1 events. 0 – request until no Class1 events or Class1 timer expires. Range of values: 0 … 255	1
Class1 Time	How long request the same data link layer, if there is Class1 events. 0 – time is not checked. Range of values: 0 … 255000 ms	0
Reconnect	How often try to reconnect to communication port if there was error. Range of values: 1 … 600 seconds	10
Answer timeout	Wait timeout of response from controlled device. Range of values: 50 … 30000 milliseconds	500
Allow E5	Enables or disables E5 response from controlled device. Values: No, Yes	Yes
Use Status link	Enables or disables use Status of link frame before Reset Link is sent. Values: No, Yes	Yes

User Data with confirm	Sends User Data with confirmation request. Values: No, Yes	Yes
Use CU	Enables to use Reset Communication Unit. Values: No, Yes	No
Use CU timeout	Use Reset CU command if no link more than this timeout. This parameter has no effect if "Use CU" is disabled. Range of values: 0 … 43200 minutes	0 – use always
Ignore DFC bit	Enables to ignore DFC bit. Values: No, Yes	Yes
Log header	Log data link header. Values: No, Yes	Yes
Log Answer Timeout	Log data link answer timeouts to system log. Values: Never, First time, Always.	First Time

4.10.1.3 Application layer parameters



Field name	Description	Default value
ID	For internal use.	

Application layer name	Application layer name. For example: “Feeder 1”.	New Application layer name
Enabled on start	Enables or disables application layer on start. Values: No, Yes	No
Common address	Common address of data unit. Range of values: 1 … 254	1
General Interrogation	Cycle time of general interrogation to the controlled device. Range of values: 1 … 86400 seconds	600
Auto add	Automatically adds all data points received after General Interrogation responses from controlled device. Values: No, Yes	Yes
Reconnect	How often try to connect to remote application. Application is considered connected, on received any application data from remote device. Range of values: 1 … 3600 seconds	600
Time synchronization	Cycle time of clock synchronization to the controlled device. Range of values: 1 … 86400 seconds	600
Day of Week	In request with timestamp use Day of Week bit. Values: No, Yes	No
Summer time	In request with timestamp use Summer time bit. Values: No, Yes	No
Allow synchronization	Enables or disables clock synchronization. Values: No, Yes	Yes
UTC time	In requests and responses use UTC time. Values: No, Yes	Yes
Generic command	Generic data request refresh rate. Range of values: 500 … 600000 ms	2000
Log header	Log headers of frames in protocol log. Values: No, Yes	Yes

LogIO	Log configured information objects to protocol log. Values: No, Yes	Yes
Log IO not configured	Log not configured points to protocol log. Values: No, Yes	No

4.10.1.4 Points

Application layer has Points branch. You can manage here signals, measurements from controlled device and commands to controlled device. You can add points manually or use the function Auto add in the application layer, which will add all data points to the list. You must add commands manually anyway, hence commands doesn't include in General Interrogation. Following figure shows points popup menu, which you can run with right mouse button. You can Add status point, Edit status point, Delete status point, Select All status points or commands. Also you can Connect or Remove connection to the Tag. You can Remove connection to source also from Tag Manager. All menu items have keyboard shortcuts. They will simplify and quicken the work with the software.

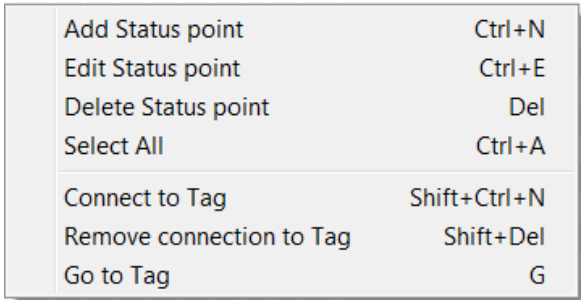

Add Status point Ctrl+N
Edit Status point Ctrl+E
Delete Status point Del
Select All Ctrl+A
Connect to Tag Shift+Ctrl+N
Remove connection to Tag Shift+Del
Go to Tag G

Figure 63. Points popup menu

Following figure shows Add new data points dialog window. The parameters which you can specify on IEC 60870-5-103 protocol are proposed in the next table.

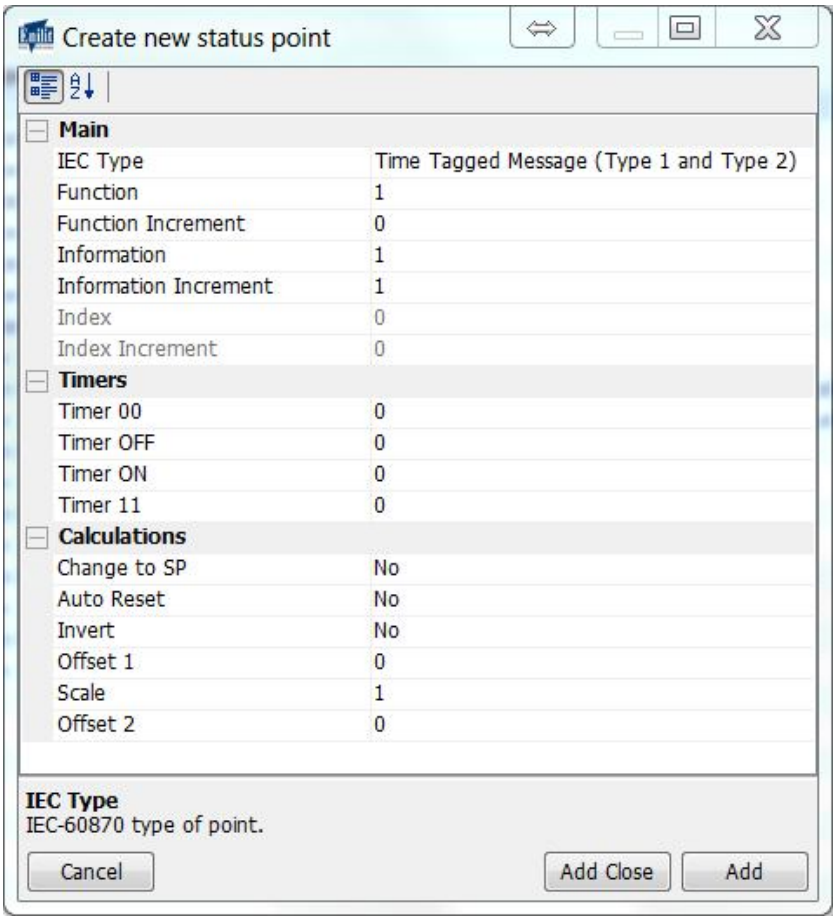


Figure 64. Add new data points

Field name	Description	Default value
IEC Type	IEC 60870-5-103 data type. Values: Time Tagged Message (Type 1 and Type 2), Measurement (Type 3 and Type 9), Measurement (Type 4), Time Tagged Message (Type 1 and Type 2) Double (composed from two Time Tagged Messages, both Time Tagged Messages should be addressed in a row).	Time Tagged Message (Type 1 and Type 2)
Function	Here, the function type of the employed protection equipment can be defined: The following paragraph lists the meaning of some of the function types: 128: Distance protection 160: Overcurrent time protection	1

	176: Transformer - differential protection 192: Line differential protection 254: Generic function type 255: Global function type For a complete list of all function types, please refer to the IEC 60870-5-103 norm. Range of values: 0...255	
Function Increment	Used only for configuration. After adding new status point function will be automatically incremented by set value.	0
Information	Here, the information number can be specified. Ranges for information numbers in monitoring direction: 0...15 System functions 16...31 Status 32...47 Monitoring 48...63 Earth faults 64...127 Short circuits 128...143 Automatic reclosing 144...159 Measured values 240...255 Generic functions Ranges for information numbers in control direction: 0...15 System functions 16....31 General commands 240...255 Generic functions For a complete list of all information numbers, please refer to the IEC 60870-5-103 norm. Range of values: 0 … 255	1
Information Increment	Used only for configuration. After adding new status point function will be automatically incremented by set value.	1
Index	Parameter is relevant only with IEC Type Measurement (Type 3 and Type 9).	1

	Range of values: 0 … 255	
Timer 00	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If received value is intermediate and timer is set to not zero, it will be delayed for set time and if some data change occurs it will be ignored. Range of values: 0 … 3600 seconds, 0 – not used	0
Timer OFF	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If received value is OFF and timer is set to not zero, it will be delayed for set time and if some data change occurs it will be ignored. Range of values: 0 … 3600 seconds, 0 – not used	0
Timer ON	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If received value is ON and timer is set to not zero, it will be delayed for set time and if some data change occurs it will be ignored. Range of values: 0 … 3600 seconds, 0 – not used	0
Timer 11	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If received value is indeterminate and timer is set to not zero, it will be delayed for set time and if some data change occurs it will be ignored. Range of values: 0 … 3600 seconds, 0 – not used	0
Change to SP	IEC-60870-5-103 protocol all status signals are double points. If you want to use single point signal in upper direction (IEC 60870-5-101 or	Unchecked

	IEC 60870-5-103 slave protocols), you must check this checkbox. Values: Checked, Unchecked	
Auto reset	IEC 60870-5-103 data Type 2 are transient signals, which means that slave device transmits only start of signal, but never transmits the end of it. In this case you must check this checkbox. Values: Checked, Unchecked	Unchecked
Invert	Inversion of signals Type 1 and Type 2. Values: Checked, Unchecked	Unchecked
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0

Following three figures shows the list of data points and commands. You can use double click to edit data or command point. You can also select many points and then edit it with keyboard shortcut Ctrl+E.

Status points | Command points

	..	..	IEC Type	.	.	Tag
1	160	148	1 Measurands (Type 3 and Type 9)			
2	160	148	2 Measurands (Type 3 and Type 9)			
3	160	148	3 Measurands (Type 3 and Type 9)			
4	160	148	4 Measurands (Type 3 and Type 9)			
5	160	148	5 Measurands (Type 3 and Type 9)			
6	160	148	6 Measurands (Type 3 and Type 9)			
7	160	148	7 Measurands (Type 3 and Type 9)			
8	160	148	8 Measurands (Type 3 and Type 9)			
9	255	10	Time Tagged Message (Type 1 and Type 2)			
10	255	11	Time Tagged Message (Type 1 and Type 2)			
11	255	12	Time Tagged Message (Type 1 and Type 2)			30 Feeder 2\Circuit breaker 1
12	255	13	Time Tagged Message (Type 1 and Type 2)			
13	255	14	Time Tagged Message (Type 1 and Type 2)	Yes	Yes	31 Feeder 2\Circuit breaker 2
14	255	15	Time Tagged Message (Type 1 and Type 2)	Yes		
15	255	16	Time Tagged Message (Type 1 and Type 2)	Yes		32 Feeder 2\Circuit breaker 3
16	255	17	Time Tagged Message (Type 1 and Type 2)	Yes		
17	255	18	Time Tagged Message (Type 1 and Type 2)	Yes		

Figure 65. List of status points

Columns between Function type and Offset 2 are status point configuration parameters. Value, Time, Quality, Cause will show real-time data from controlled device.

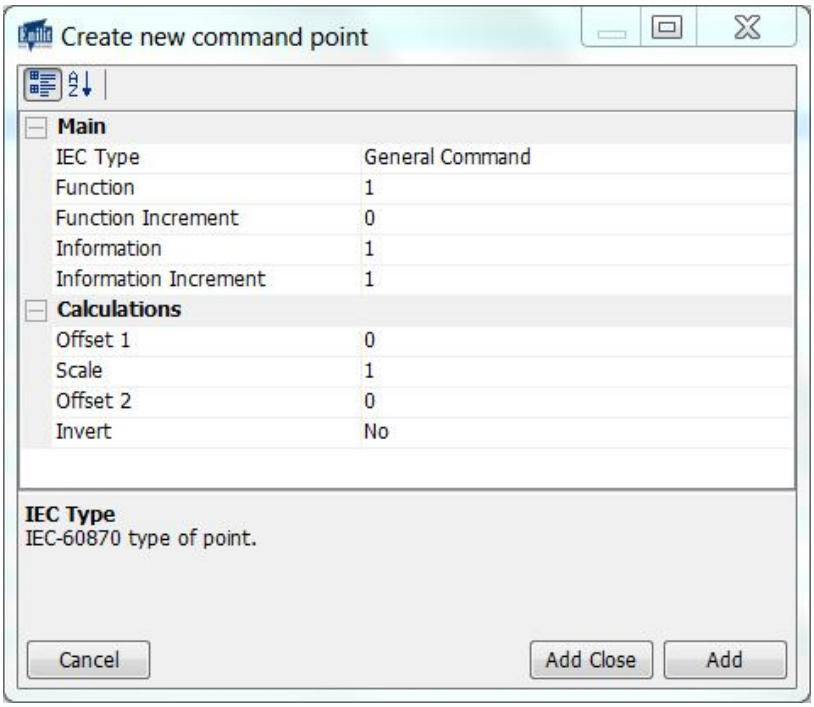


Figure 66. Create new command point window

Field name	Description	Default value
IEC Type	IEC 60870-5-103 data type. Values: General Command General Command Double (composed from to General Commands which is addressed in a row)	General Command
Function	Here, the function type of the employed protection equipment can be defined: The following paragraph lists the meaning of some of the function types: For a complete list of all function types, please refer to the IEC 60870-5-103 norm. Range of values: 0...255	1
Function Increment	Used only for configuration. After adding new command, function will be automatically incremented by set value.	0
Information	Here, the information number can be specified. Ranges for information numbers in monitoring direction:	1

	Range of values: 0 … 255	
Information Increment	Used only for configuration. After adding new command, function will be automatically incremented by set value.	1
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of signals Type 1 and Type 2. Values: Checked, Unchecked	Unchecked

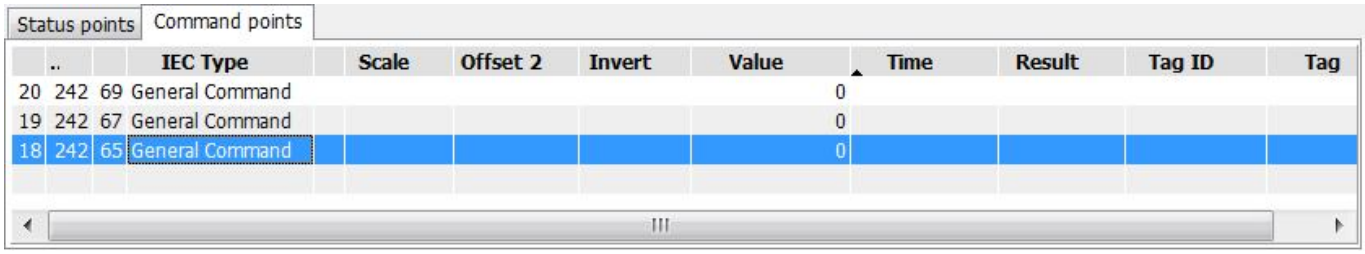

Status points
Command points
.. IEC Type Scale Offset 2 Invert Value Time Result Tag ID Tag
20 242 69 General Command 0
19 242 67 General Command 0
18 242 65 General Command 0

Figure 67. List of commands

In the Command points window Value, Time will show last transmitted command data. Result will show response from controlled device.

4.10.1.5 Measured information coefficient calculation

Sometimes it is hard to understand how Scale parameter is calculated to get real value of measurement. Most of relays for measurement transmission use coefficients – 1.2 or 2.4 (It is according to IEC-60870-103 standard). We will name it COF.

According IEC-60870-103 standard measurements are transmitted in range from -4096 to 4096.

ScaleI=Inom* COF/4096;

ScaleU=Unom* COF/4096;

ScaleUL=Unom* COF*$\sqrt{3}$/4096;

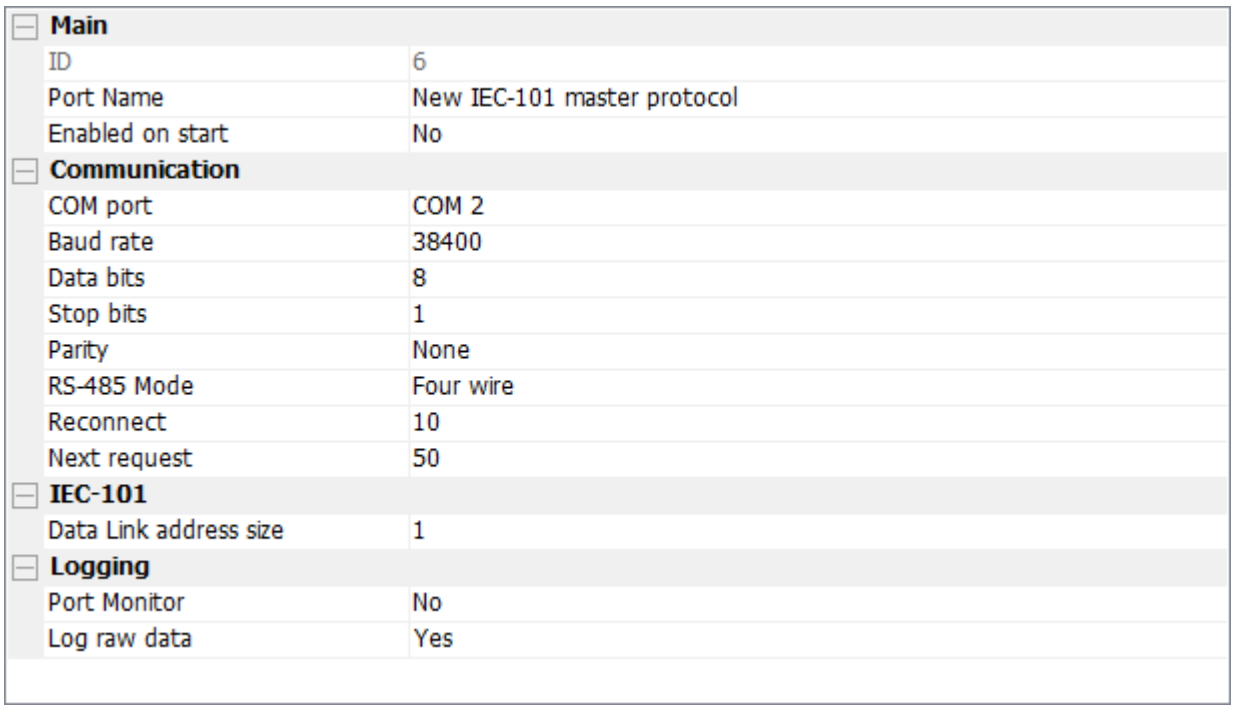
ScaleP= Inom*Unom* COF*$\sqrt{3}$/4096;

ScaleQ= Inom*Unom* COF*$\sqrt{3}$/4096;

Remember if you use kilovolts in equations, so for power you will get kilowatts and so on.

4.10.2 IEC 60870-5-101 configuration

4.10.2.1 Communication port parameters



Field name	Description	Default value
ID	For internal use.	
Port name	Name of the port and protocol. For example: “COM2 IEC-101 master protocol”	New IEC-101 master protocol
Enabled on start	Port enabled on system startup. Values: No, Yes	No
Com port	Communication port number. Range of values: 1 … 255	Not assigned
Baud rate	Serial port baud rate. Range of values: 110 … 921600	38400
Data bits	Serial port data bits. Values: 7, 8	
Stop bits	Serial port stop bits. Values: 1, 1.5, 2	1
Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	None

RS-485 Mode	If used two wires mirrored data check should be used. If serial port is RS-232, parameter is not important. Range of values: Four wires, Two wires	Four wire
Reconnect	How often try to connect to communication port if there was error. Range of values: 1 … 600 seconds	10
Next request	Wait time before sending next request Range of values: 0 … 1000 ms	50
Data link address size	Data link layer address size in bytes. Range of values: 0 … 2 bytes	1
Port monitor	Show port monitor on system startup. Values: No, Yes	No
Log raw data	Log raw communication data. Values: No, Yes	Yes

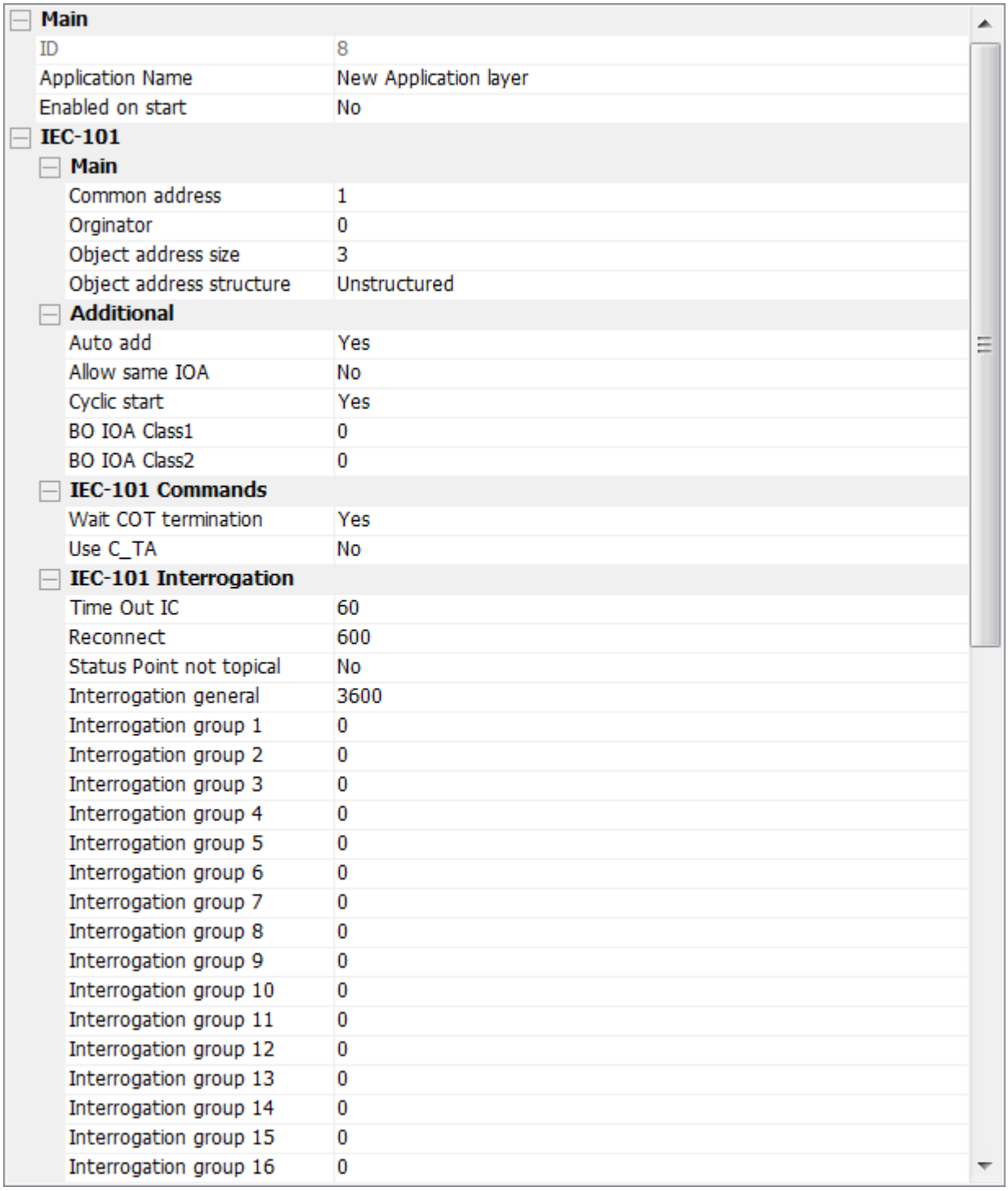
4.10.2.2 Data link layer parameters

Main	
ID	7
Data Link Name	New Data link layer
Enabled on start	No
IEC-101	
Main	
Data Link address	1
COT size	1
CAA size	2
Frame size	255
Time Outs	
Broken link	5
Priority	1
Class1 Count	1
Class1 Time	0
Reconnect	10
Answer timeout	500
Other	
Allow E5	Yes
Use Status link	Yes
User Data with confirm	Yes
Logging	
Log header	Yes
Log Answer TimeOut	First Time

Field name	Description	Default value
ID	For internal use.	
Data link name	Data link layer name. For example: “Measurements data controller”.	New Data Link layer
Enabled on start	Enables or disables data link on start. Values: No, Yes	No
Data link address	Data link address Range of values: 1 … 65534 (if Data link addr. length is set to 2), 1 … 254 (if Data link address length is set to 1), If Data link address length is set to 0, this parameter is not used.	1
COT size	Cause of transmission size Range of values: 1 … 2 bytes	1
CAA size	Common address size Range of values: 1 … 2 bytes	2
Frame size	Maximum frame length Range of values: 50 … 255 bytes	255
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 10	5
Priority	Request data every cycle. Range of values: 1 … 255	1
Class1 Count	How many times request the same data link layer, if there is Class1 events. 0 – request until no Class1 events or Class1 timer expires. Range of values: 0 … 255	1
Class1 Time	How long request the same data link layer, if there is Class1 events. 0 – time is not checked. Range of values: 0 … 255000 ms	0
Reconnect	How often try to reconnect to communication port if there was error. Range of values: 1 … 600 seconds	10

Answer timeout	Wait timeout of response from controlled device. Range of values: 50 … 30000 milliseconds	500
Allow E5	Enables or disables E5 response from controlled device. Values: No, Yes	Yes
Use Status link	Enables or disables use Status of link frame before Reset Link is sent. Values: No, Yes	Yes
User Data with confirm	Sends User Data with confirmation request. Values: No, Yes	Yes
Log header	Log data link header. Values: No, Yes	Yes
Log Answer Timeout	Log data link answer timeouts to system log. Values: Never, First time, Always.	First Time

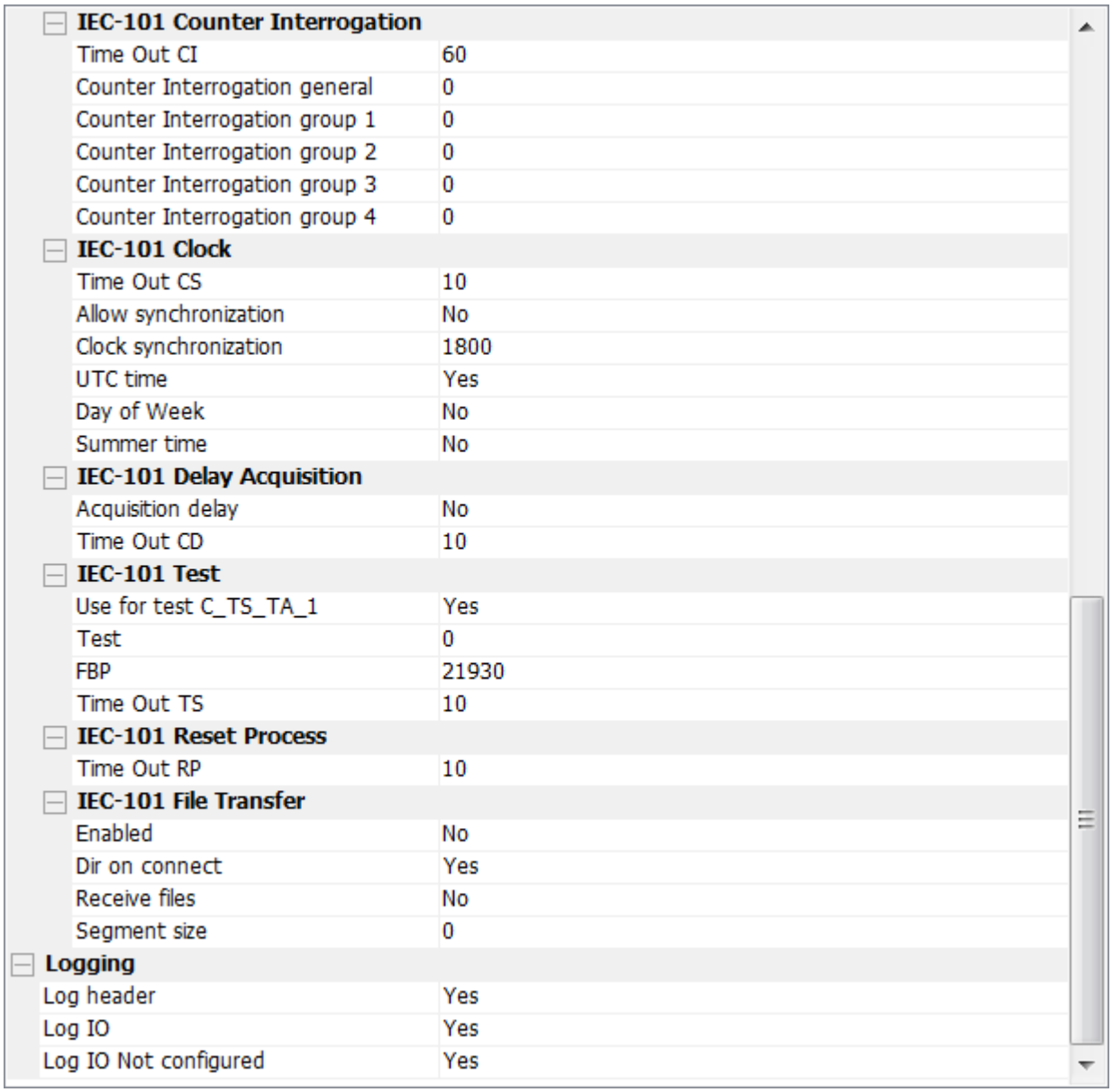
4.10.2.3 Application layer parameters



Field name	Description	Default value
ID	For internal use.	
Application name	Application link layer name. For example: “Measurements data controller”.	New Application Link layer
Enabled on start	Enables or disables application on start.	No

	Values: No, Yes	
Common address	Common address of data unit. Range of values: 1 … 254	1
Originator	Originator Range of values: 0 … 255	0
Object address size	Size of information object address Range of values: 1 … 3	3
Object address structure	Object address structure shows in what format information object address is entered in configuration. Range of values: Unstructured, Structured 8.8.8, Structured 8.16, Structured 16.8, Structured 8.8	Unstructured
Auto add	Automatically adds all data points received after General Interrogation to the controlled device. Values: No, Yes	Yes
Allow same IOA	Allow to have same information object address for status and command points. Values: No, Yes	No
Cyclic start	Yes – next cyclic operation time is calculated at the end of operation. No – next cyclic operation time is calculated at the start of operation. Values: No, Yes	Yes
BO IOA Class1	Information object address of buffer overflow for Class1. Range of values: 0 - 16777215	0 – not used
BO IOA Class2	Information object address of buffer overflow for Class2. Range of values: 0 - 16777215	0 – not used

Wait COT termination	Wait response of activation termination for set points. Values: No, Yes	Yes
Use C_TA	Enables to use commands with timestamp. Values: No, Yes	No
Timeout IC	Timeout for interrogation commands. Range of values: 1 … 3600 seconds	60
Reconnect	If application layer is not connected how often to send station interrogation command. Range of values: 1 … 3600 seconds	10
Interrogation general	Cycle time of General Interrogation to the controlled device. Range of values: 1 … 86400 seconds	3600
Interrogation group 1 … 16	Cycle time of Group Interrogation to the controlled device. Range of values: 0 … 86400 seconds	0 – disabled Group Interrogation



Field name	Description	Default value
Timeout CI	Timeout for Counter Interrogation requests. Range of values: 0 … 3600 seconds	60
Counter Interrogation general	Cycle time of Counter Interrogation to the controlled device. Range of values: 0 … 86400 seconds	0 – disabled Counter Interrogation
Counter Interrogation group 1 … 4	Cycle time of Counter Interrogation group to the controlled device. Range of values: 0 … 86400 seconds	0 – disabled Counter Interrogation
Timeout CS	Timeout for clock synchronization. Range of values: 1 … 3600 seconds	10

Allow synchronization	Enables or disables clock synchronization. Values: No, Yes	Yes
Clock synchronization	Cycle time of clock synchronization to the controlled device. Range of values: 1 … 86400 seconds	600
UTC time	Enables to use UTC time in requests and responses. Values: No, Yes	Yes
Day of Week	In request with timestamp use Day of Week bit. Values: No, Yes	No
Summer time	In request with timestamp use Summer time bit. Values: No, Yes	No
Acquisition delay	Use acquisition delay before sending clock synchronization (C_CD_NA_1). Values: No, Yes	No
Timeout CD	Timeout for delay acquisition. Range of values: 1 … 3600 seconds	10
Use for test C_TS_TA_1	Use test frame format C_TS_TA_1. Values: No, Yes	Yes
Test	Cycle time of test frame. This parameter is not used, when Is test frame used are set to No. Range of values: 1 … 86400 seconds	0 - disabled
FBP	Fixed test bit pattern Range of values: 0 … 32768	21930
Timeout TC	Timeout for test command. Range of values: 1 … 3600 seconds	10
Timeout RP	Timeout for reset process. Range of values: 1 … 3600 seconds	10
Enabled	Enables file transfer function. Values: No, Yes	No
Dir on connect	Request directory after connection starts. Values: No, Yes	Yes
Receive files	After receive list of files, download all files from controlled device.	No

	Values: No, Yes	
Segment size	Segment size to use in file transfer. 0 – segment size is calculated from max frame length. If segment size plus headers is more than max frame length, segment size will be calculated from max frame length. Range of values: 0 … 255 bytes	0
Log header	Log application layer header. Values: No, Yes	Yes
Log IO	Log information objects. Values: No, Yes	Yes
Log IO not configured	Log not configured information objects. Values: No, Yes	Yes

4.10.2.4 Points

Following figure shows data points of IEC 60870-5-101 protocol.

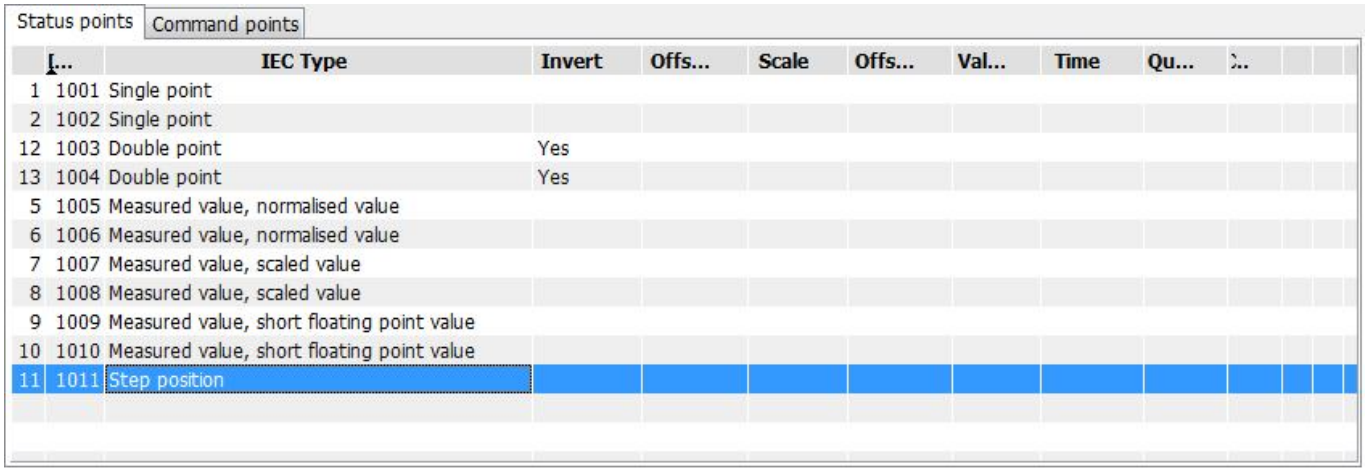

Status points
Command points
I... IEC Type Invert Offs... Scale Offs... Val... Time Qu...
1 1001 Single point
2 1002 Single point
12 1003 Double point Yes
13 1004 Double point Yes
5 1005 Measured value, normalised value
6 1006 Measured value, normalised value
7 1007 Measured value, scaled value
8 1008 Measured value, scaled value
9 1009 Measured value, short floating point value
10 1010 Measured value, short floating point value
11 1011 Step position

Figure 68. IEC 60870-5-101 status points table

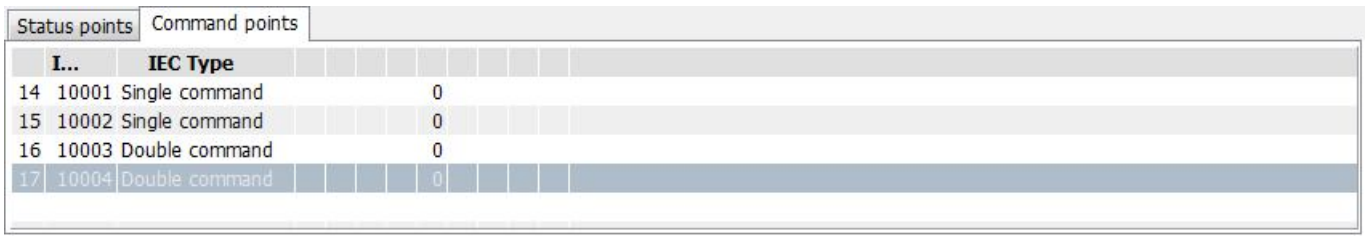


Figure 69. IEC 60870-5-101 command points table

Following figure shows Add new data points IEC 60870-5-101 protocol. You can use very useful function Auto increment by 1. For example, you need to configure some points with information addresses in interval 1001 and 1010. You can configure first point with 1001 address and then check the checkbox Auto

increment by 1. Then you can click Add button and in this case it will not close the dialog, but automatically configure information address with 1002. So you will get 10 points with only 10 mouse clicks.

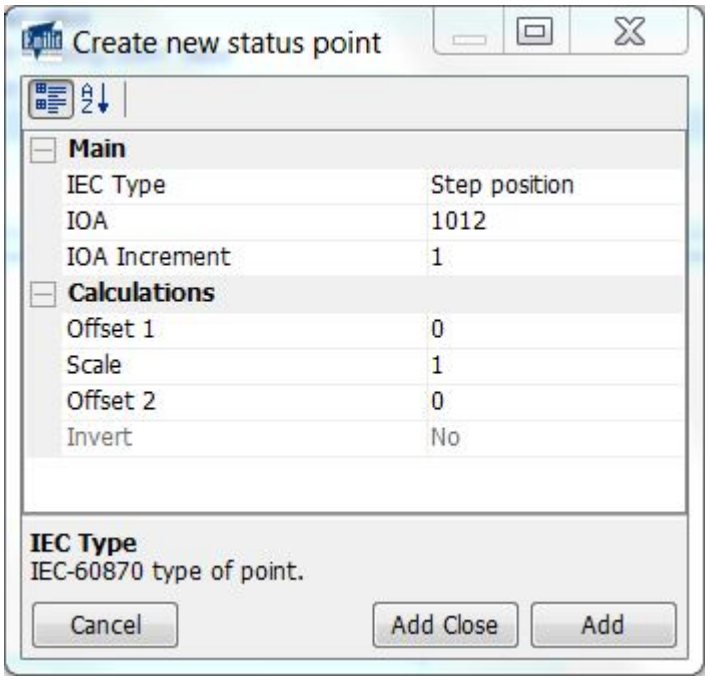


Figure 70. Add new data point IEC 60870-5-101

Field name	Description	Default value
Information address	Here, the information address can be specified. Range of information address depends from Application layer parameter Information object address length. Range of values: 0 … 16777215	1
IEC Type	IEC 60870-5-101 data type. Values: Single point Double point Step position Bit string of 32 bits Measured value, normalized value Measured value, scaled value Measured value, short floating point value	Single Point
Calculations	Calculation of status item. New Value = (Old value + Offset1) * Scale + Offset2	No conversion

Invert	Inversion of signals Type 1 and Type 2. Values: No, Yes	No

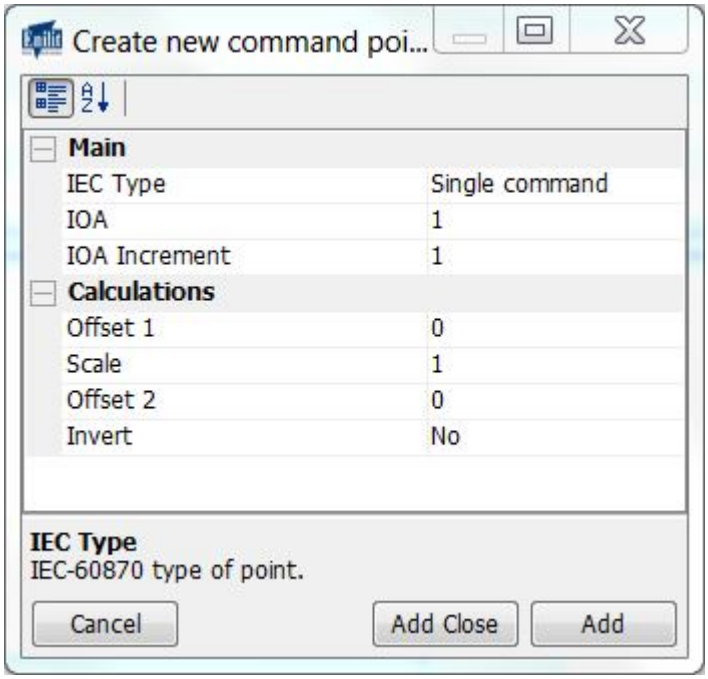


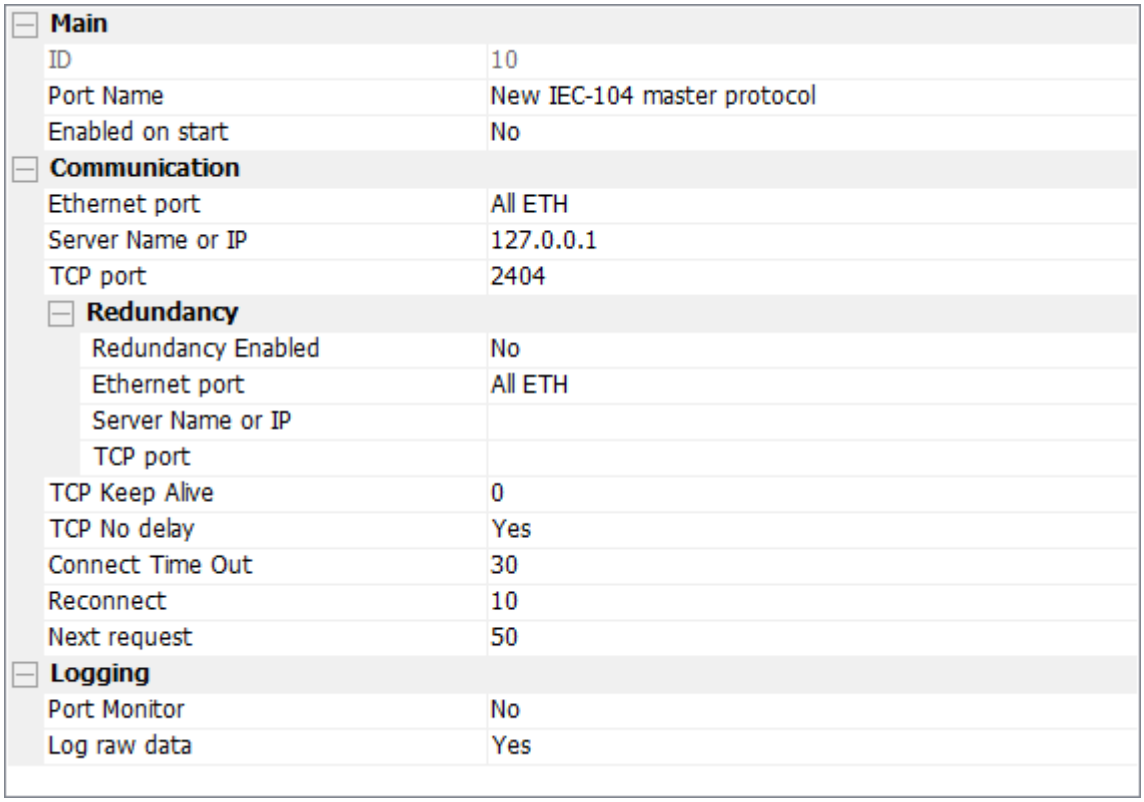
Figure 71. Add new command points IEC 60870-5-101

Field name	Description	Default value
Information address	Here, the information address can be specified. Range of information address depends from Application layer parameter Information object address length. Range of values: 0 … 16777215	1
IEC Type	IEC 60870-5-101 command type. Values: Single command Double command Regulating step command Setpoint normalized command Setpoint scaled command Setpoint short float command Bitstring command	Single Command
Calculations	Calculation of status item. New Value =	No conversion

	(Old value + Offset1) * Scale + Offset2	
Invert	Inversion of command. Values: No, Yes	No

4.10.3 IEC 60870-5-104 configuration

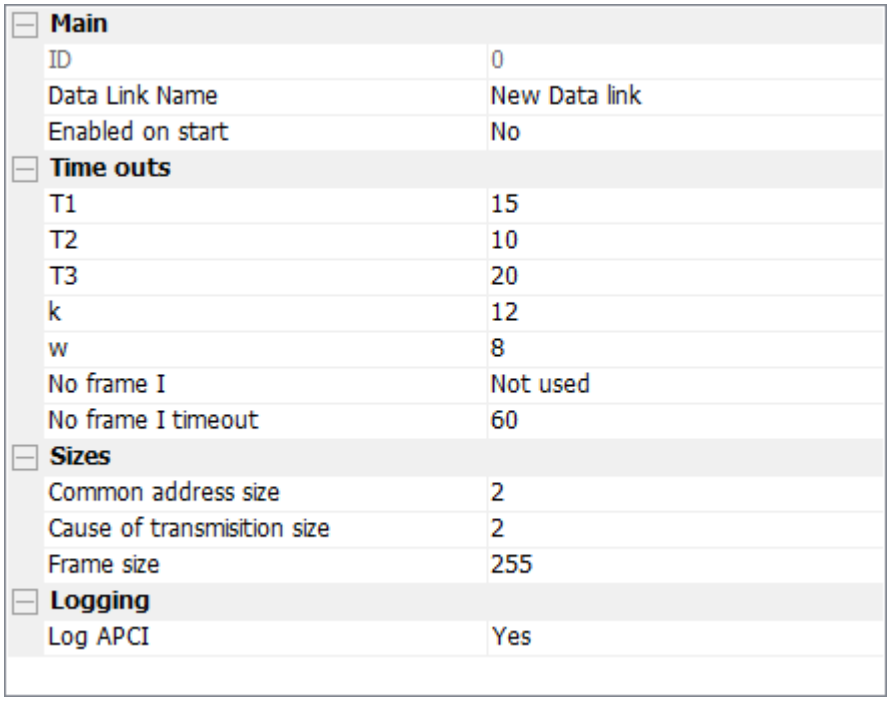
4.10.3.1 Communication port parameters



Field name	Description	Default value
ID		
Port name	Port name. For example: “IEC-104 master 172.29.37.113”.	New IEC-104 master protocol
Enabled on start	Enables or disables communication port on start. Values: No, Yes	No
Ethernet port	Which Ethernet port to use for connection to server. Values: All ETH, ETH 1, ETH 2, ETH 3.	All ETH
Server name or IP	Name or IPv4 address of the host.	127.0.0.1
TCP port	TCP port. Range of values: 1 … 65535	2404

Redundancy enabled	Enables or disables redundant communication. Values: No, Yes	No
Ethernet port	Redundant Ethernet port to use for connection to server. Values: All ETH, ETH 1, ETH 2, ETH 3.	All ETH
Server name or IP	Name or IPv4 address of the redundant host.	
TCP port	Redundant TCP port. Range of values: 1 … 65535	
TCP Keep Alive	TCP Keep Alive. Do not set low values, because it will add overhead to communication. Range of values: 0 … 2147483647 milliseconds	0 - disabled
TCP No delay	TCP No delay disables the Nagle Algorithm. Values: No, Yes	Yes
Connect Timeout		
Reconnect	If the connection is broken, cycle time of reconnection. Range of values: 1...600 seconds	10
Next request	Wait time before sending next request Range of values: 0 … 1000 ms	50
Port monitor	Show port monitor on system startup. Values: No, Yes	No
Log raw data	Log raw communication data. Values: No, Yes	Yes

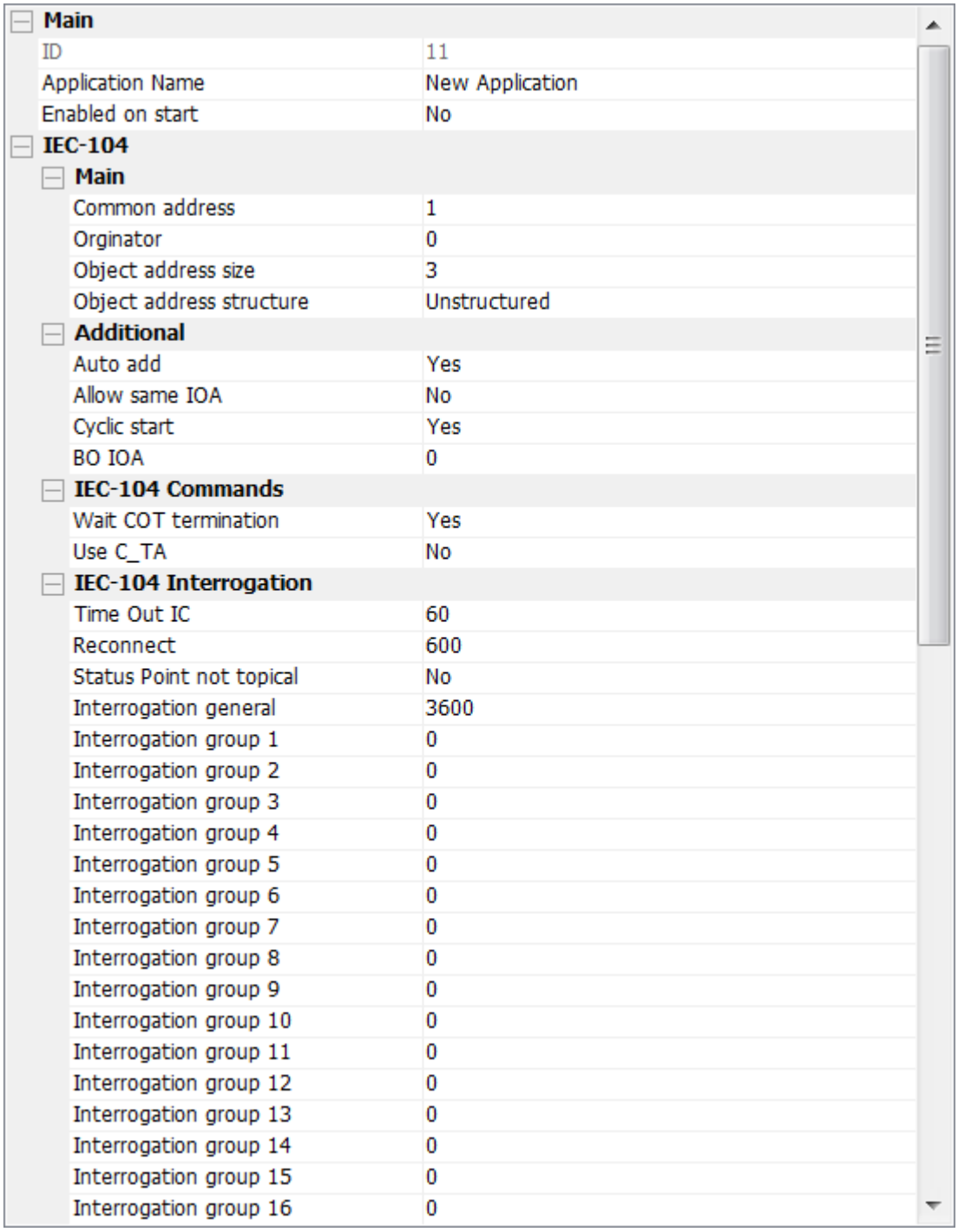
4.10.3.2 Data layer parameters



Field name	Description	Default value
ID		
Data link name	Data link name. For example: “Data link”.	New Data link
Enabled on start	Enables or disables communication port on start. Values: No, Yes	No
T1	Acknowledgement time-out 1 Range of values: 1...600 seconds	15
T2	Acknowledgement time-out 2 Range of values: 1...600 seconds	10
T3	Connection test timeout Range of values: 1...600 seconds	20
k	Maximum number of unacknowledgments ADPUs Range of values: 1...32,767	12
w	Maximum number of received ADPUs for acknowledgments Range of values: 1...32,767	8
No frame I	Change behavior of I frame. Values: Not used, Send STOP DT, Disconnect.	Not used

No frame I timeout	Timeout of I frame Range of values: 1...600 seconds	60
Common address size	Common address size Range of values: 1 … 2 bytes	2
Cause of transmission size	Cause of transmission size Range of values: 1 … 2 bytes	2
Frame size	Maximum frame size. All start, stop, checksum and other bytes are included. Range of values: 50 … 255 bytes	255
Log APCI	Log Application Protocol Control Information. Values: No, Yes	Yes

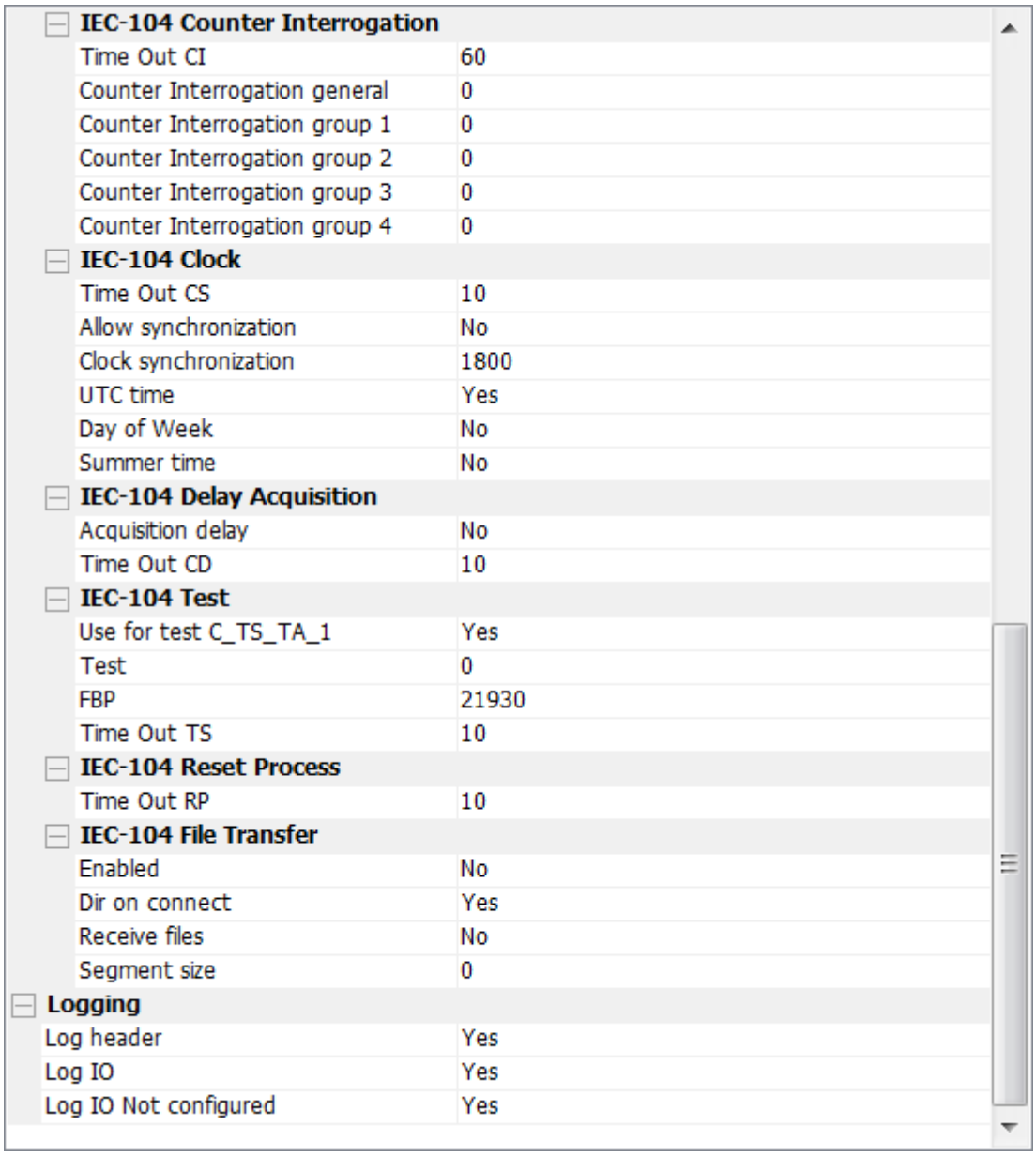
4.10.3.3 Application layer parameters



Field name	Description	Default value
ID	For internal use.	
Application name	Application layer name. For example: “Other RTU”.	New Application link layer
Enabled on start	Enables or disables application on start. Values: No, Yes	No
Common address	Common address of data unit.	1

	Range of values: 1 … 254	
Originator	Originator Range of values: 0 … 255	0
Object address size	Size of information object address Range of values: 1 … 3	3
Object address structure	Object address structure shows in what format information object address is entered in configuration. Range of values: Unstructured, Structured 8.8.8, Structured 8.16, Structured 16.8, Structured 8.8	Unstructured
Auto add	Automatically adds all data points received after General Interrogation to the controlled device. Values: No, Yes	Yes
Allow same IOA	Allow to have same information object address for status and command points. Values: No, Yes	No
Cyclic start	Yes – next cyclic operation time is calculated at the end of operation. No – next cyclic operation time is calculated at the start of operation. Values: No, Yes	Yes
BO IOA	Information object address of buffer overflow. Range of values: 0 - 16777215	0 – not used
Wait COT termination	Wait response of activation termination for set points. Values: No, Yes	Yes
Use C_TA	Enables to use commands with timestamp. Values: No, Yes	No
Timeout IC	Timeout for interrogation commands. Range of values: 1 … 3600 seconds	60

Reconnect	If application layer is not connected how often to send station interrogation command. Range of values: 1 … 3600 seconds	10
Interrogation general	Cycle time of General Interrogation to the controlled device. Range of values: 1 … 86400 seconds	3600
Interrogation group 1 … 16	Cycle time of Group Interrogation to the controlled device. Range of values: 0 … 86400 seconds	0 – disabled Group Interrogation



Field name	Description	Default value
Timeout CI	Timeout for Counter Interrogation requests.	60

	Range of values: 0 … 3600 seconds	
Counter Interrogation general	Cycle time of Counter Interrogation to the controlled device. Range of values: 0 … 86400 seconds	0 – disabled Counter Interrogation
Counter Interrogation group 1 … 4	Cycle time of Counter Interrogation group to the controlled device. Range of values: 0 … 86400 seconds	0 – disabled Counter Interrogation
Timeout CS	Timeout for clock synchronization. Range of values: 1 … 3600 seconds	10
Allow synchronization	Enables or disables clock synchronization. Values: No, Yes	Yes
Clock synchronization	Cycle time of clock synchronization to the controlled device. Range of values: 1 … 86400 seconds	600
UTC time	Enables to use UTC time in requests and responses. Values: No, Yes	Yes
Day of Week	In request with timestamp use Day of Week bit. Values: No, Yes	No
Summer time	In request with timestamp use Summer time bit. Values: No, Yes	No
Acquisition delay	Use acquisition delay before sending clock synchronization (C_CD_NA_1). Values: No, Yes	No
Timeout CD	Timeout for delay acquisition. Range of values: 1 … 3600 seconds	10
Use for test C_TS_TA_1	Use test frame format C_TS_TA_1. Values: No, Yes	Yes
Test	Cycle time of test frame. This parameter is not used, when Is test frame used are set to No. Range of values: 1 … 86400 seconds	0 - disabled
FBP	Fixed test bit pattern Range of values: 0 … 32768	21930
Timeout TC	Timeout for test command.	10

	Range of values: 1 … 3600 seconds	
Timeout RP	Timeout for reset process. Range of values: 1 … 3600 seconds	10
Enabled	Enables file transfer function. Values: No, Yes	No
Dir on connect	Request directory after connection starts. Values: No, Yes	Yes
Receive files	After receive list of files, download all files from controlled device. Values: No, Yes	No
Segment size	Segment size to use in file transfer. 0 – segment size is calculated from max frame length. If segment size plus headers is more than max frame length, segment size will be calculated from max frame length. Range of values: 0 … 255 bytes	0
Log header	Log application layer header. Values: No, Yes	Yes
Log IO	Log information objects. Values: No, Yes	Yes
Log IO not configured	Log not configured information objects. Values: No, Yes	Yes

4.10.3.4 Points

Status points | Command points

ID	IOA	IEC Type	Inv...	Offs...	Sc...	Offs...	Val...	Ti...	Quali...	Ca...	Tag ID
1	900	Single point									
2	901	Single point									
3	902	Double point									
4	903	Double point									
5	904	Measured value, normalised value									
6	905	Measured value, normalised value									
7	906	Measured value, scaled value									
8	907	Measured value, scaled value									
9	908	Measured value, short floating point value									
10	909	Measured value, short floating point value									

Figure 72. Status points

Status points | Command points

ID	IOA	IEC Type	Offs...	Scale	Offs...	Invert	Val...	Time	Result	Tag ID	Tag
11	5001	Single command					0				
12	5002	Single command					0				
13	5003	Double command					0				
14	5004	Double command					0				
15	5005	Set point short float co...					0				
16	5006	Regulating step command					0				

Figure 73. Command points

Configuration of IEC 60870-5-104 protocol data and command points are the same like of IEC 60870-5-101 protocol. Refer to the paragraph above.

4.10.4 IEC 61850 client

Enilit RTU supports also IEC 61850 client protocol. You can connect IED devices via 61850 protocol standard. The main requirement is that you will need SCD (Substation Configuration Description) file extracted from IED device configuration software. SCD file is part of Substation Configuration Language (SCL).

4.10.4.1 Communication port

Main	
ID	7
Port Name	New IEC-61850 client protocol
Enabled on start	No
IEC-61850	
Communication	
Ethernet port	All ETH
SCD	
SCD file	D:\Projects\Enilit\Training 2013-10-07\Icd temp\001.SCD
SCD	ID7_IEC61850.SCD

Field name	Description	Default value
ID	For internal use.	
Port name	IEC 61850 port name. For example: “IEC-61850 client protocol”.	New IEC 61850 client protocol
Enabled on start	Enables or disables port on start. Values: No, Yes	No
Ethernet port	Which Ethernet port to use for connection to server. Values: All ETH, ETH 1, ETH 2, ETH 3.	All ETH

SCD file	SCD file of substation. You can browse the file with Open file dialog button .... Values: File name and path.	
SCD	Enilit CMS saves the file in Projects SCD folder.	

When you select SCD file, the main parameters like IP address, Gateway, Subnet mask are taken from SCD file automatically. You should see following figure with your IEDs.

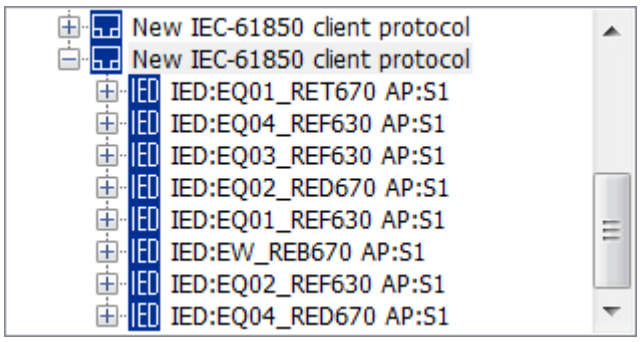


Figure 74. Imported IED devices from SCD file

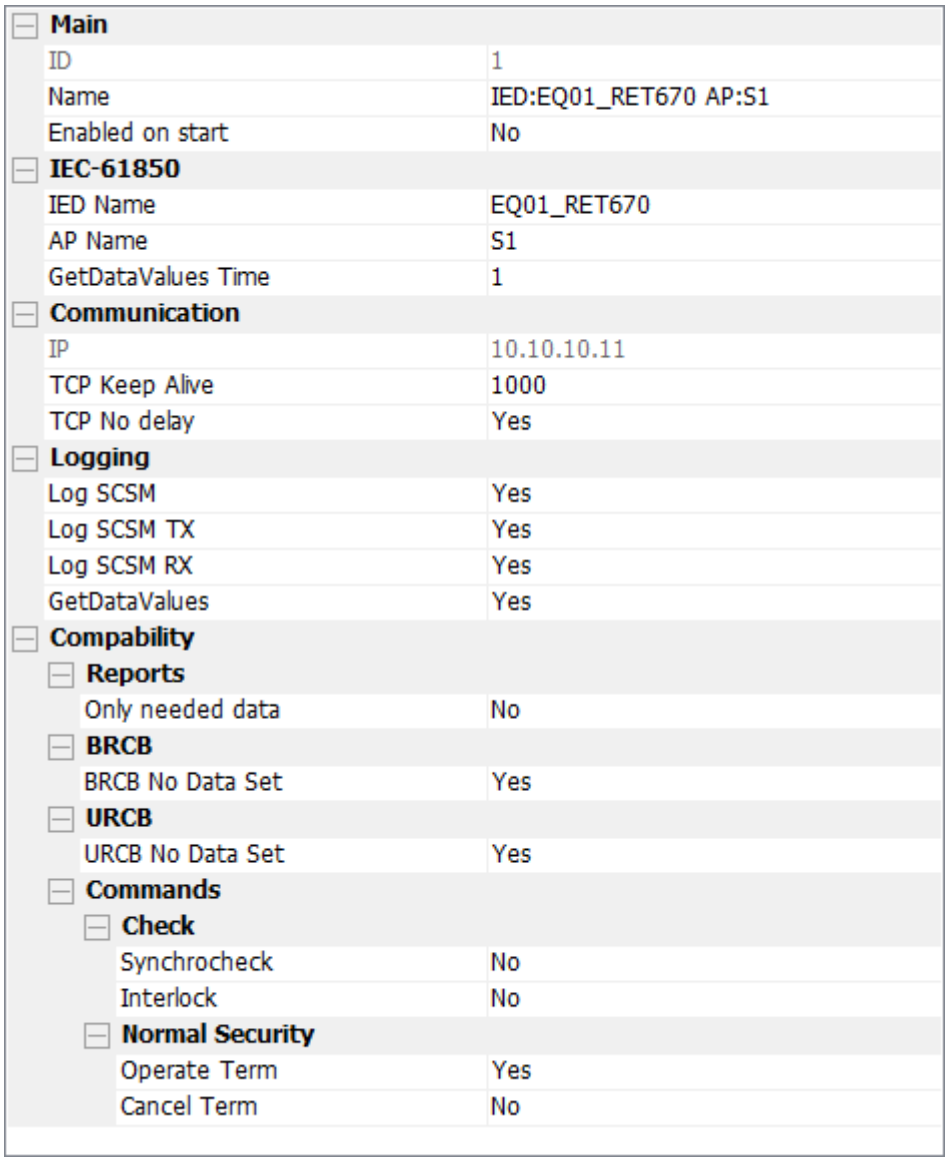


Figure 75. IEC 61850 IED device parameters window

Field name	Description	Default value
ID	For internal use.	Read only
Name	Name of IED.	After import from SCD file name will be concatenated from IED Name and AP Name
Enabled on start	IED is enabled on system startup. Values: No, Yes	No
IED Name	IED name in SCD file.	
AP Name	Access point name in SCD file.	
IP	IP address of IED in SCD file.	Read only
TCP Keep Alive	TCP Keep Alive. Do not set low values, because it will add overhead to communication. Range of values: 0 … 2147483647 milliseconds	0 - disabled
TCP No delay	TCP No delay disables the Nagle Algorithm. Values: No, Yes	Yes
Log SCSM	Log SCSM communication. Values: No, Yes	Yes
Log SCSM TX	Log SCSM requests. Values: No, Yes	Yes
Log SCSM RX	Log SCSM responses. Values: No, Yes	Yes
GetDataValues	Enables log GetDataValues requests and responses. Values: No, Yes	Yes
Only needed data	Start only buffered and unbuffered reports which contains needed data. Values: No, Yes	No
BRCB No Data Set	Print error in system log, if for buffered report control block dataset is not set. Values: No, Yes	Yes
URCB No Data Set	Print error in system log, if for unbuffered report control block dataset is not set. Values: No, Yes	Yes

Synchrocheck	Set synchrocheck bit in command to YES. Values: No, Yes	No
Interlock	Set interlock bit in command to YES. Values: No, Yes	No
Operate Term	Wait for command termination, in case of negative operate response. Values: No, Yes	Yes
Cancel Term	Wait for command termination, in case of negative cancel response. Values: No, Yes	No

4.10.4.2 Points

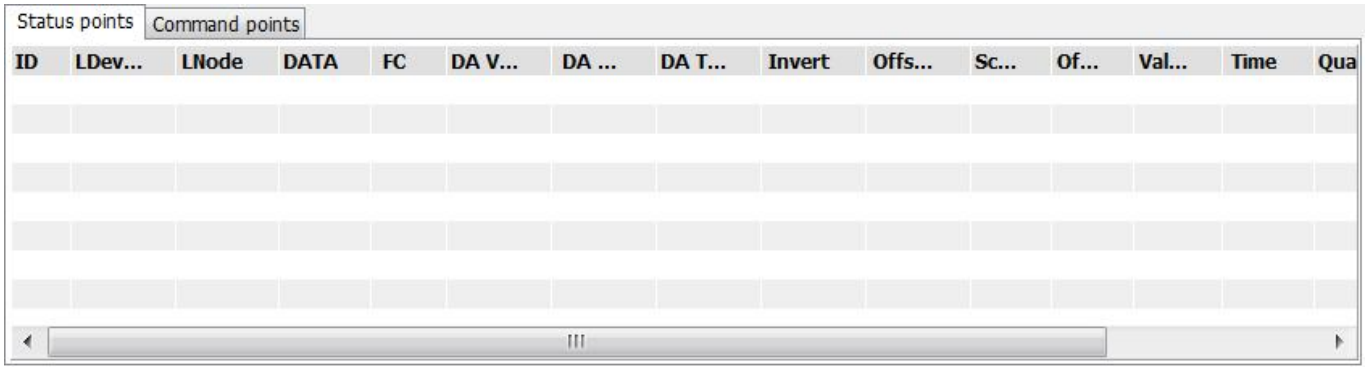


Figure 76. Points window IEC 61850

Following figure shows add data point popup menu. With it you can Browse ICD, Add data point, Edit data point, Delete data point, Select All data points and Remove connection to Tag, Import and Export points.

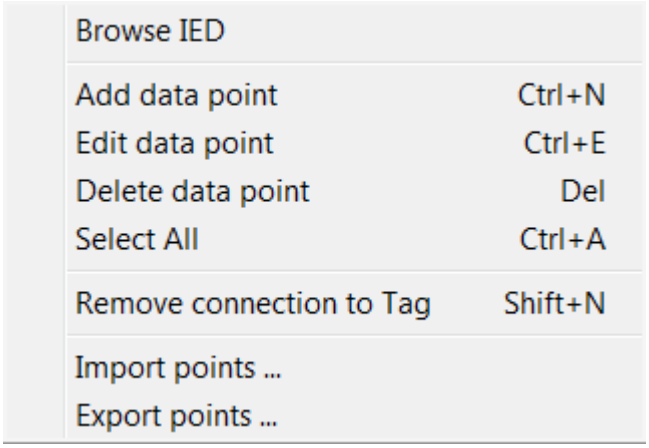


Figure 77. Data points popup menu IEC 61850

If you select from the above menu Browse ICD file, following ICD file window will open. There you can choose which data point to add to the data points list. This is an automated way to create data points IEC 61850. Browse data point you needed and double click to add it to the points list.

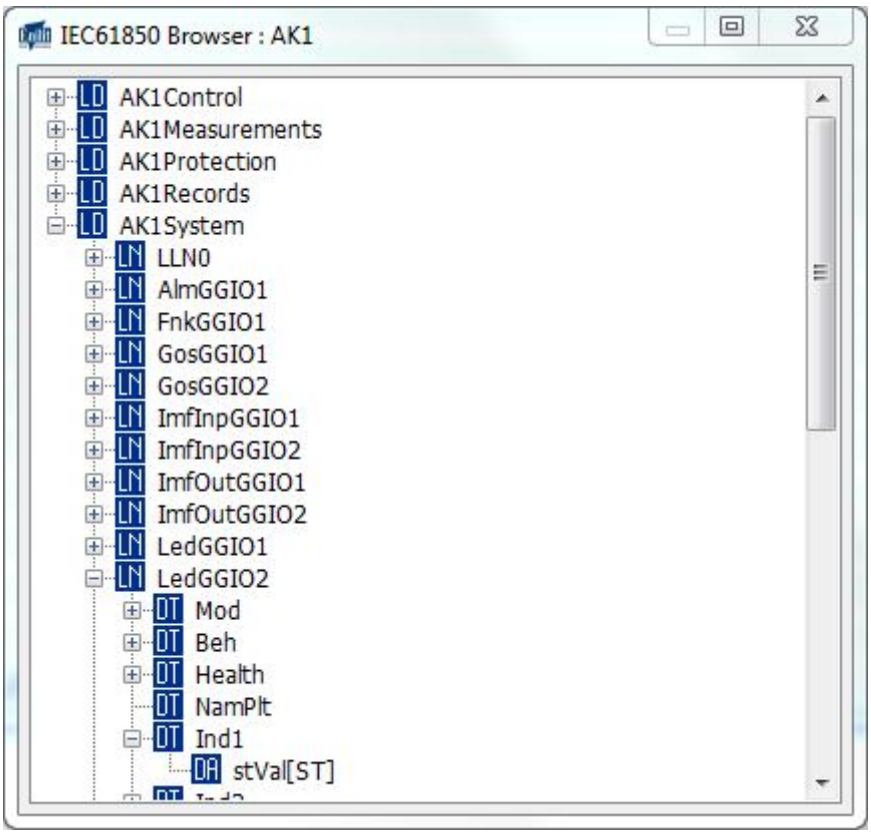


Figure 78. Add new data points from IEC 61850 ICD file

If you choose to Add new data points manually, you will see following dialog box. You must enter information like Logical device, Logical node, Data object, Functional constraint, Data attribute, Time attribute, Quality attribute, Invert and Value variables.

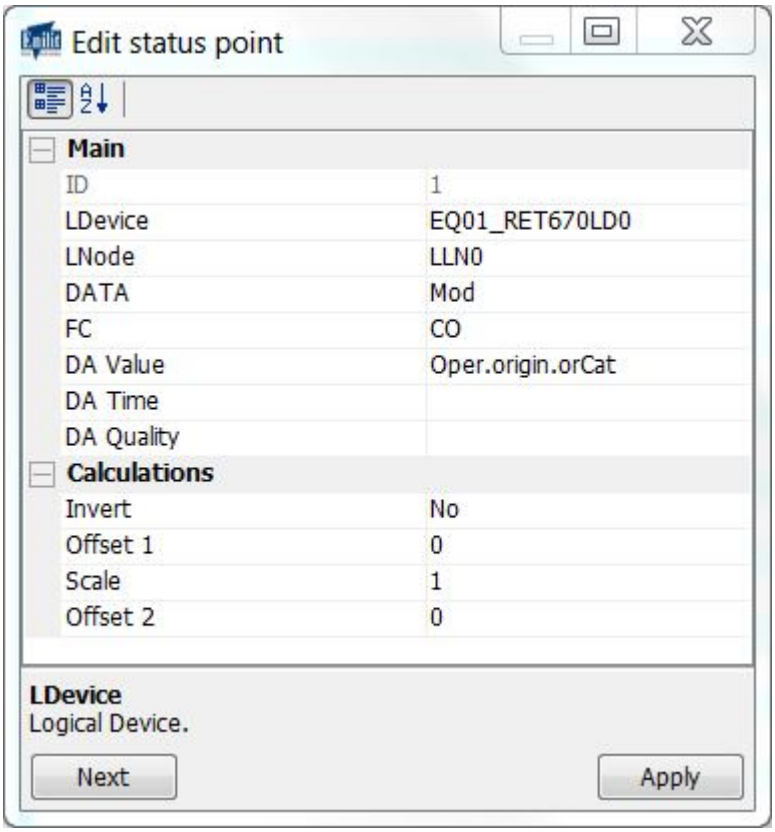


Figure 79. Add new data points manually IEC 61850

Field name	Description	Default value
LDevice	Logical device name of IEC 61850 structure. For example: “System”	
LNode	Logical device node of IEC 61850 structure. Each logical device contains one or more logical nodes. A logical node is a named grouping of data and associated services that is logically related to some power system function. For example: “LLN0”	
DATA	Data object name of IEC 61850 structure. Each logical node contains one or more elements of Data. Each element of data has a unique name. These Data Names are determined by the standard and are functionally related to the power system purpose. For example: “DPC”	
FC	Functional constraints for status (ST) attributes, substituted value (SV) attributes, description	ST

	(DC) attributes, measurement attributes (MX), and extended definition (EX) attributes Values: MX, ST	
DA Value	Data attribute for Value. For example: “stVal”	
DA Time	Data attribute for Time.	
DA Quality	Data attribute for Quality.	
Calculations	Calculation of status item. New Value = (Old value + Offset1) * Scale + Offset2	No conversion
Invert	Inversion of command. Values: No, Yes	No

Following figure shows manual creation of new command points for IEC 61850 protocol.

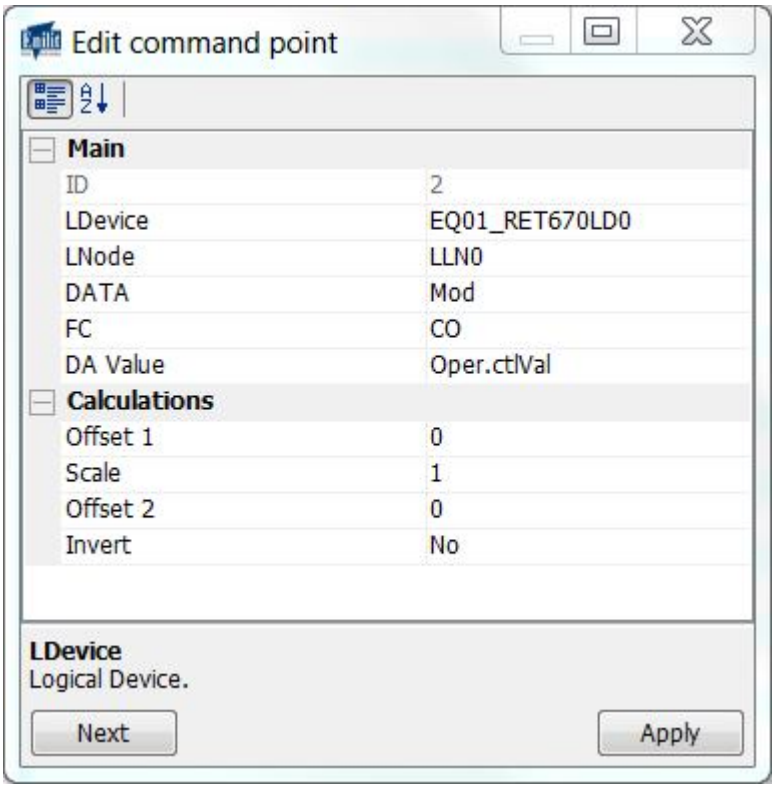


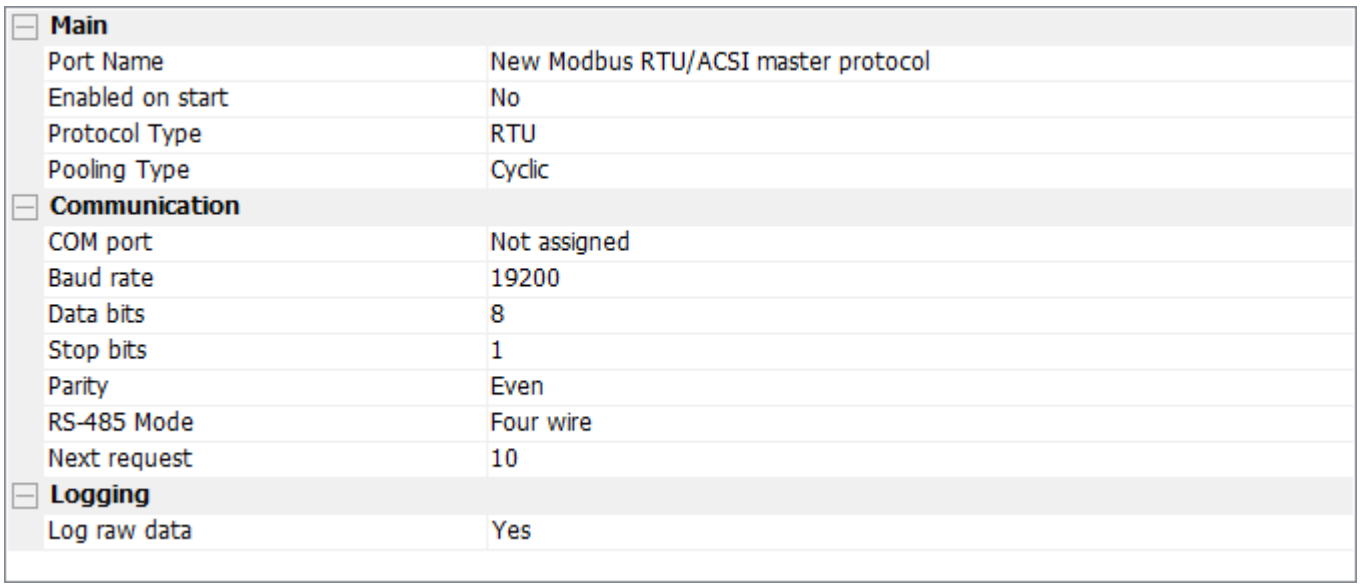
Figure 80. Add new command points manually IEC 61850

Field name	Description	Default value
LDevice	Logical device name of IEC 61850 structure. For example: “System”	
LNode	Logical device node of IEC 61850 structure.	

	Each logical device contains one or more logical nodes. A logical node is a named grouping of data and associated services that is logically related to some power system function. For example: “LLN0”	
DATA	Data object name of IEC 61850 structure. Each logical node contains one or more elements of Data. Each element of data has a unique name. These Data Names are determined by the standard and are functionally related to the power system purpose. For example: “DPC”	
FC	Functional constraints for status (ST) attributes, substituted value (SV) attributes, description (DC) attributes, measurement attributes (MX), and extended definition (EX) attributes Values: MX, ST	ST
DA Value	Data attribute for Value. For example: “stVal”	
Calculations	Calculation of status item. New Value = (Old value + Offset1) * Scale + Offset2	No conversion
Invert	Inversion of command. Values: No, Yes	No

4.10.5 Modbus RTU/ASCII

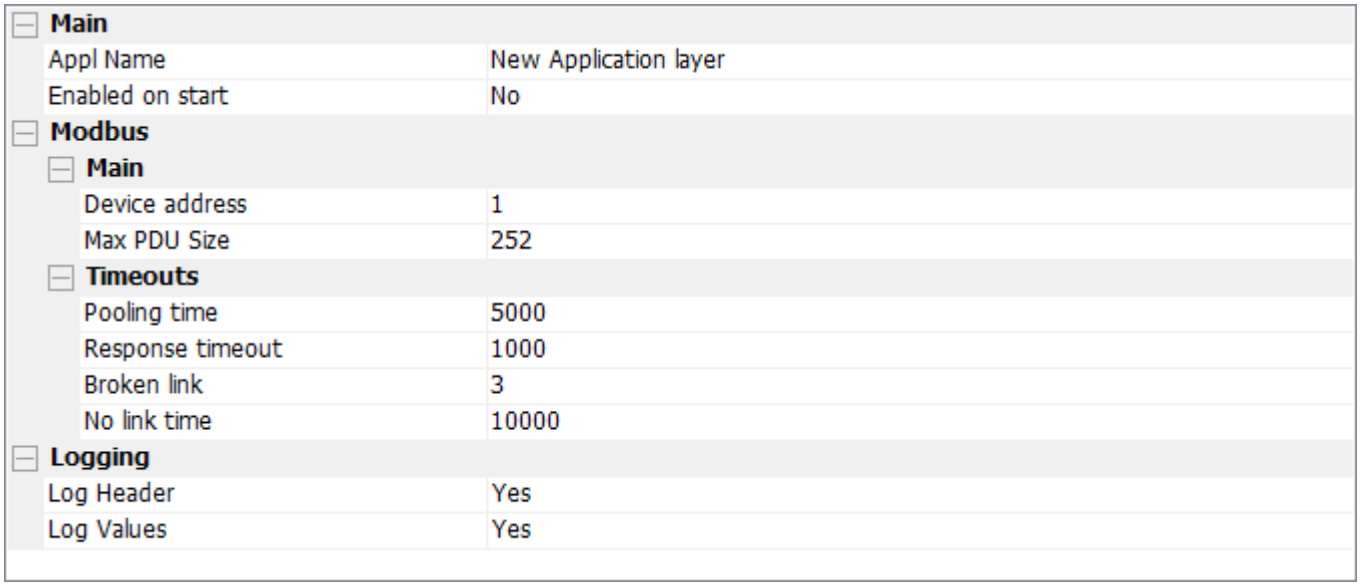
4.10.5.1 Communication port parameters



Field name	Description	Default value
Port name	Name of the port and protocol. For example: “COM1 Modbus master”	New Modbus RTU/ASCII master protocol
Enabled on start	Port enabled on system startup. Values: No, Yes	No
Protocol type	Enables to select protocol version. Values: RTU/ASCII	RTU
Polling type	“One by one” means first polling all data from first device, then second and so on. “Cyclic” means sending first request to first device, second request to second device and so on. Values: Cyclic, One by one	Cyclic
Com port	Communication port number. Range of values: COM 1 … 255	Not assigned
Baud rate	Serial port baud rate. Range of values: 110 … 921600	19200
Data bits	Serial port data bits. Values: 7,8	8
Stop bits	Serial port stop bits. Values: 1, 1.5, 2	1

Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	Even
RS-485 mode	If used two wires mirrored data check should be used. If serial port is RS-232, parameter is not important. Values: Two wires, Four wires.	Four wires
Next request	Wait time before sending next request. Range of values: 0 … 1000 ms	10
Log raw data	Log raw communication data. Values: No, Yes	Yes

4.10.5.2 Application layer parameters



Field name	Description	Default value
Application layer name	Application layer name. For example: “Application layer”.	New Application layer name
Enabled on start	Enables or disables application layer on start. Values: No, Yes	No
Device address	Device link address. Range of values: 1 … 255	1
Max PDU Size	Maximum PDU size in bytes. Range of values: 10 … 252	252
Pooling time	The time to pool the data. Range of values: 50 … 65535 ms	5000
Response timeout	Time to wait response after request.	1000

	Range of values: 10 … 65535 ms	
Broken link	Determine the connection as broken after so many retries. Range of values: 1 … 100	3
No link time	Request data every this time when connection is broken. Range of values: 100 … 65535 ms	10000
Log header	Enables to log headers in Port Monitor. Values: No, Yes	Yes
Log values	Enables to log values in Port Monitor. Values: No, Yes	Yes

4.10.5.3 Points

To add new data or command point to the points list you must call popup menu in the Points window. With the following menu items you can Add, Edit or Delete data points, Select all or Remove connection to the Tag manager. Import and Export functionality included also.

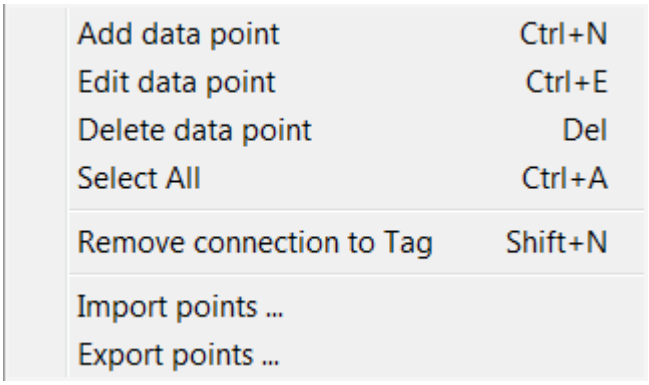


Figure 81. Points window popup menu

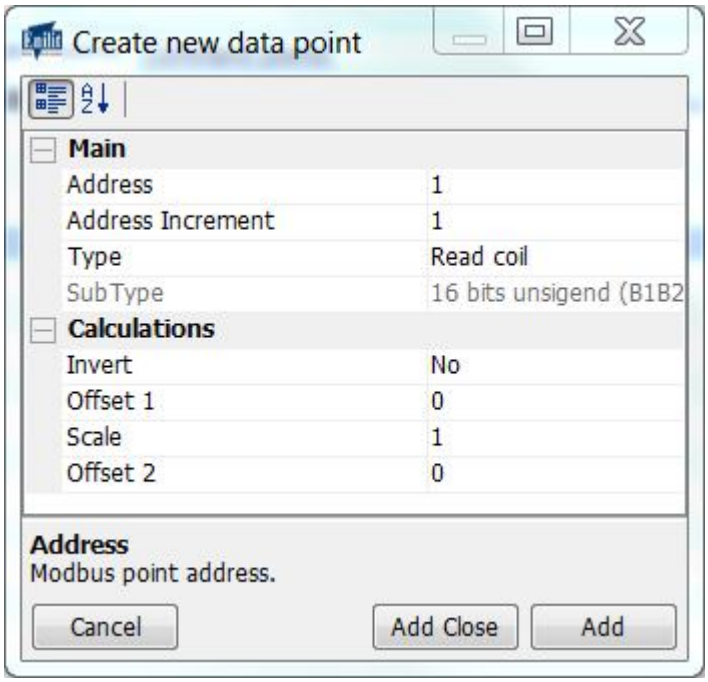


Figure 82. Add new data point window

Field name	Description	Default value
Address	Here, the information address can be specified. Range of values: 0 … 65535	1
Modbus type	Modbus data type. Values: 1. Read coil 2. Read discrete input 3. Read holding register 4. Read input register	Read coil
Data subtype	Available only if Modbus type is Read holding register or Read input register. Available data subtypes: 16 bits unsigned (B1B2), 16 bits unsigned (B2B1), 16 bits signed (B1B2), 16 bits signed (B2B1), 32 bits unsigned in one register (B1B2B3B4), 32 bits unsigned in one register (B4B3B2B1), 32 bits signed in one register (B1B2B3B4), 32 bits signed in one register (B4B3B2B1),	

	32 bits unsigned in two register (B1B2B3B4), 32 bits unsigned in two register (B4B3B2B1), 32 bits signed in two register (B1B2B3B4), 32 bits signed in two register (B4B3B2B1), 32 bits float in one register (B1B2B3B4), 32 bits float in one register (B4B3B2B1), 32 bits float in two register (B1B2B3B4), 32 bits float in two register (B4B3B2B1)	
Invert	Inversion of command. Values: No, Yes	No
Calculations	Calculation of status item. New Value = (Old value + Offset1) * Scale + Offset2	No conversion

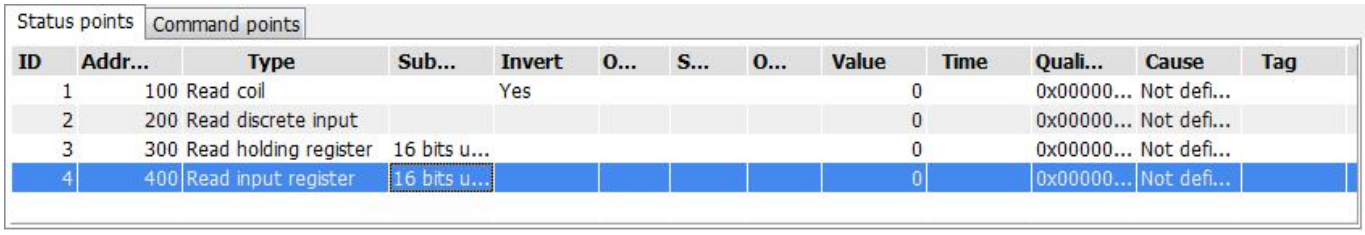

Status points
Command points
ID Addr... Type Sub... Invert O... S... O... Value Time Quali... Cause Tag
1 100 Read coil Yes 0 0x00000... Not defi...
2 200 Read discrete input 0 0x00000... Not defi...
3 300 Read holding register 16 bits u... 0 0x00000... Not defi...
4 400 Read input register 16 bits u... 0 0x00000... Not defi...

Figure 83. Data points window

Columns between Function and Offset 2 are data point configuration parameters. Value, Time, Quality will show real-time data from controlled device.

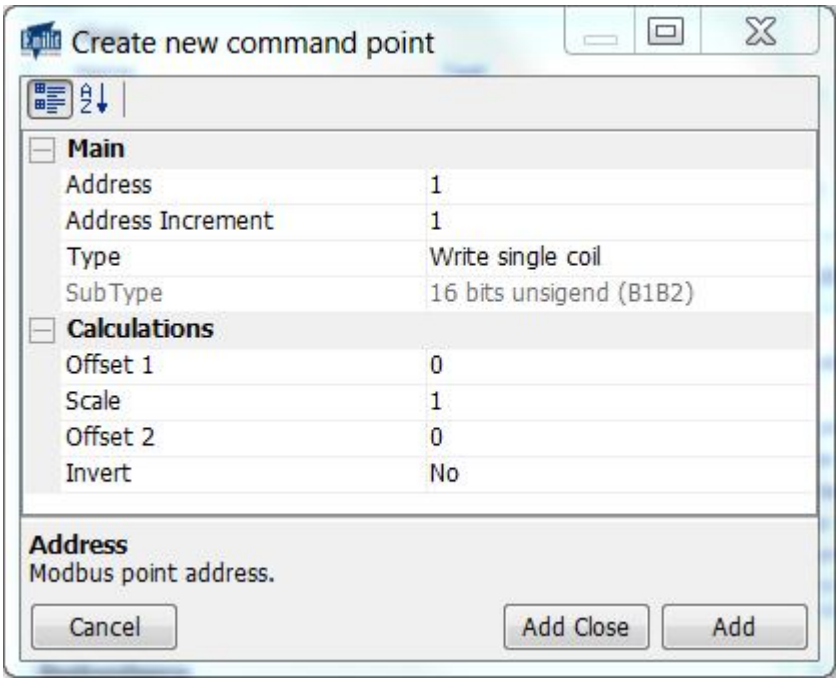


Figure 84. Add new command points window

Field name	Description	Default value
Address	Here, the information address can be specified. Range of values: 0 … 65535	1
Modbus type	Modbus data type. Values: 1. Write single coil 2. Write single register	Write single coil
Data subtype	Available only if Modbus type is Write single register. Available data subtypes: 16 bits unsigned (B1B2), 16 bits unsigned (B2B1), 16 bits signed (B1B2), 16 bits signed (B2B1)	
Calculations	Calculation of status item. New Value = (Old value + Offset1) * Scale + Offset2	No conversion
Invert	Inversion of command. Values: No, Yes	No

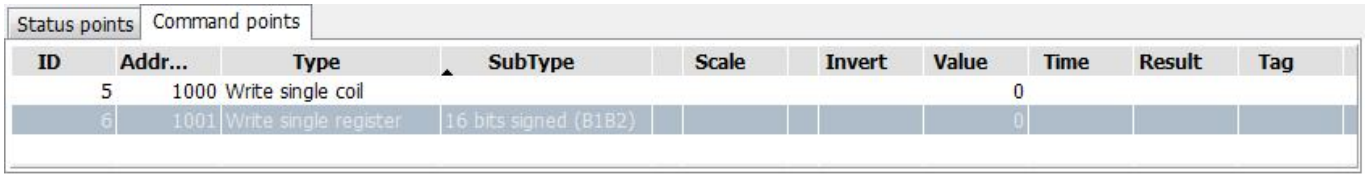
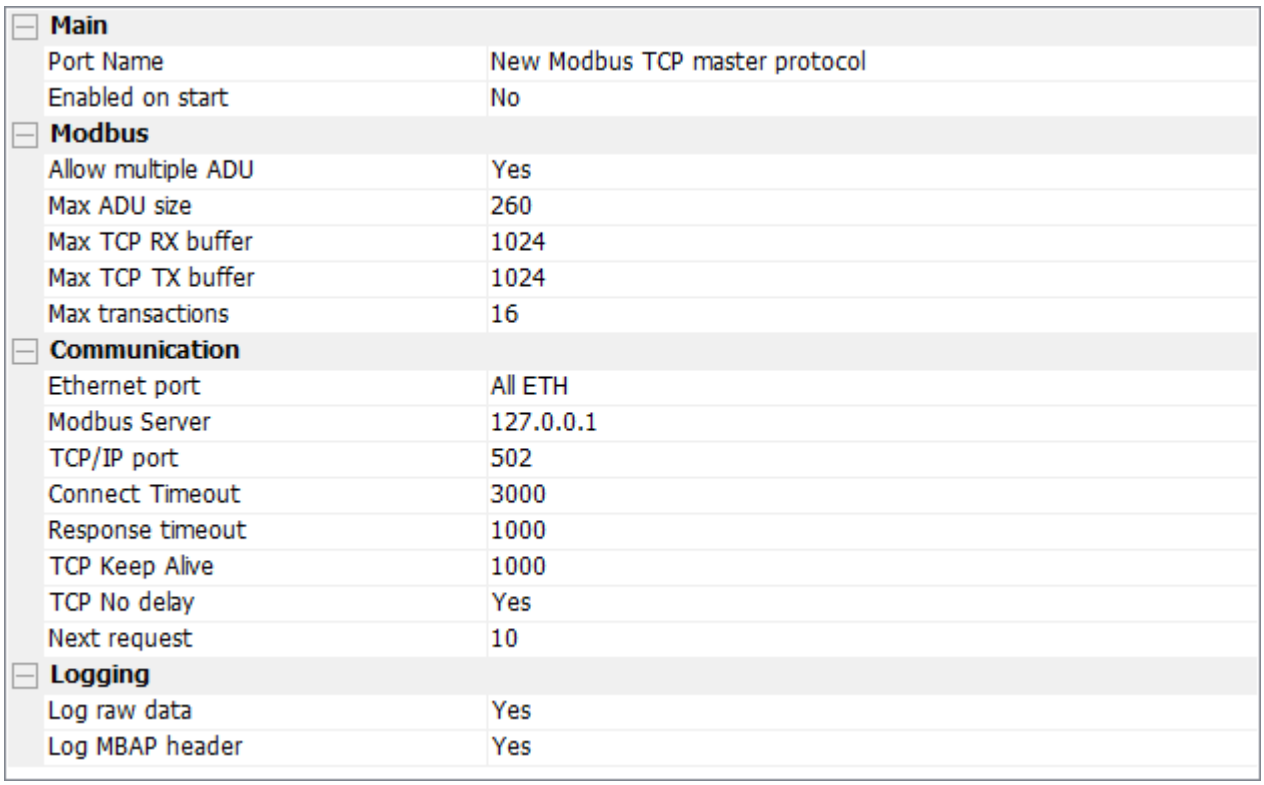


Figure 85. Commands window

In the Command points window Value, Time will show last transmitted command data. Result will show response from controlled device.

4.10.6 Modbus TCP client

4.10.6.1 Communication port parameters

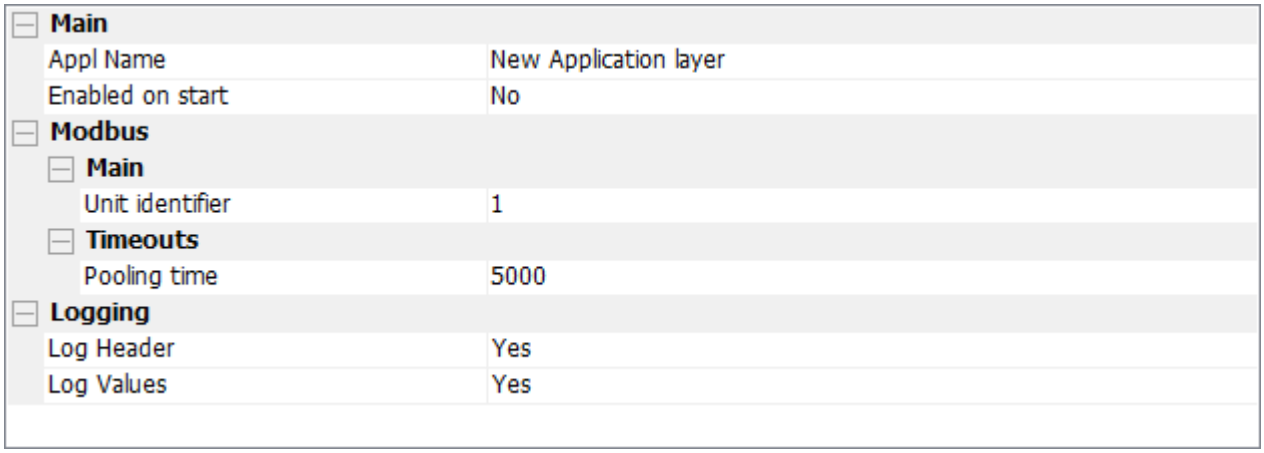


Main	
Port Name	New Modbus TCP master protocol
Enabled on start	No
Modbus	
Allow multiple ADU	Yes
Max ADU size	260
Max TCP RX buffer	1024
Max TCP TX buffer	1024
Max transactions	16
Communication	
Ethernet port	All ETH
Modbus Server	127.0.0.1
TCP/IP port	502
Connect Timeout	3000
Response timeout	1000
TCP Keep Alive	1000
TCP No delay	Yes
Next request	10
Logging	
Log raw data	Yes
Log MBAP header	Yes

Field name	Description	Default value
Port name	Name of the port and protocol. For example: “TCP Modbus client”	New Modbus TCP master protocol
Enabled on start	Port enabled on system startup. Values: No, Yes	No
Allow multiple ADU	Allow multiple ADU in one TCP frame. Values: No, Yes	Yes
Max ADU size	Maximum ADU size. Range of values: 20 … 260 bytes	260
Max TCP RX buffer	Maximum servers receive buffer size. Range of values: 300 … 10000	1024
Max TCP TX buffer	Maximum clients transmit buffer size. Range of values: 300 … 10000	10224
Max transaction	Maximum transaction on the same time Range of values: 1 … 16	16

Ethernet port	Which Ethernet port to use for connection to server. Values: All ETH, ETH 1, ETH 2, ETH 3.	All ETH
Modbus Server	Server IP address. Values: xxx.zzz.yyy.nnn	127.0.0.1
TCP/IP Port	TCP port for TCP/IP connection. Must be the same port on the server side. Values: 1 … 65535	502
Connect Timeout	TCP connect timeout. Range of values: 1 … 60 seconds	3
Response timeout	Time to wait response after request. Range of values: 0 … 65535 ms	1
TCP Keep Alive	Force TCP activity when idle to long. Do not set low values, because it will add overhead to communication. Range of values: 0 … 2147483647	1000
TCP No delay	Enables or disables the Nagle algorithm. Values: No, Yes	Yes
Next request	Time to wait before new request is transmitted. Range of values: 1 … 65535 ms	10
Log raw data	Enables to log raw data in Port Monitor. Values: No, Yes	Yes
Log MBAP header	Enables to log Modbus application headers in Port Monitor. Values: No, Yes	Yes

4.10.6.2 Application layer parameters



Field name	Description	Default value
Appl Name	Application layer name. For example: “Application layer”.	New Application layer
Enabled on start	Enables or disables application layer on start. Values: No, Yes	No
Unit identifier	Slave Address (255 if not used) Range of values: 0 … 255	1
Pooling time	The time to pool the data. Range of values: 50 … 65535 ms	5000
Log header	Enables to log headers in Port Monitor. Values: No, Yes	Yes
Log values	Enables to log values in Port Monitor. Values: No, Yes	Yes

4.10.6.3 Points

Refer to the Modbus RTU/ASCII paragraph “Points”.

4.10.7 DNP3 serial master configuration

4.10.7.1 Communication port parameters

Field name	Description	Default value
Baud rate	Serial port baud rate. Range of values: 110 … 921600	38400
Com port	Communication port number. For example with default value will be used COM1.	1

	Range of values: 1 … 255	
Data bits	Serial port data bits. Values: 7,8	8
Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	None
Stop bits	Serial port stop bits. Values: 1, 1.5, 2	1
Port enabled	Port enabled on system startup. Values: No, Yes	No
Port name	Name of the port and protocol. For example: “COM1 DNP3 master”	“New Communication Port”

4.10.7.2 Data link layer parameters

Field name	Description	Default value
Master address	RTU’s master address Range of values: 0 … 65535 bytes	1
Slave address	IED slave address Range of values: 0 … 65535 bytes	2
Answer timeout	Wait timeout of response from controlled device. Range of values: 50 … 30000 milliseconds	500
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 10	5
No link cycle	This parameter is important if there is no link to the controlled device. With default value it sends requests every tenth cycle. Range of values: 1 … 10	10
Ask data every	This parameter is important if you have more than one controlled device on one communication port. You can use it for raring data requests to the desirable device. Range of values: 1 … 10	1
Data link name	Data link layer name.	New Data Link layer

	For example: “Measurements data controller”.	
Enabled on start	Enables or disables data link on start. Values: No, Yes	Yes

4.10.7.3 Application layer parameters

Field name	Description	Default value
Time UTC	Use UTC time in communication. Values: No, Yes	Yes
Time synchronization	Cycle time of clock synchronization to the controlled device. Range of values: 1 … 86400 seconds	600
Use time synchronization	Enables or disables clock synchronization. Values: No, Yes	Yes
Application timeout	DNP3 application layer answer timeout Range of values: 0..255 seconds	10 seconds
Class 0 pooling	Period of class 0 data pooling 0 – no pooling Range of values: 0..3600 seconds	1800 seconds
Application layer name	Application layer name. For example: “Application layer”.	New Application layer name
Enabled on start	Enables or disables application layer on start. Values: No, Yes	Yes

4.10.7.4 Points

Refer to the IEC-101 paragraph “Points”. (The configuration is very similar)

4.10.8 DNP3 UDP/TCP/IP client configuration

4.10.8.1 Communication port parameters

Field name	Description	Default value
Port	TCP port Range of values: 1 … 65535	2404
Server	IPv4 address of the host.	127.0.0.1
Master address	RTU’s master address Range of values: 0 … 65535 bytes	1

Slave address	IED slave address Range of values: 0 … 65535 bytes	2
Reconnect	If the connection is broken, cycle time of reconnection. Range of values: 1...600 seconds	10
T0	Connection timeout Range of values: 1...600 seconds	30
UDP	Use UDP or TCP type No – TCP Yes - UDP	No
Port enabled	Enables or disables communication port on start. Values: No, Yes	Yes
Port name	Port name. For example: “IEC-104 master 172.29.37.113”.	New communication port name

4.10.8.2 Application layer parameters

Field name	Description	Default value
Time UTC	Use UTC time in communication. Values: No, Yes	Yes
Time synchronization	Cycle time of clock synchronization to the controlled device. Range of values: 1 … 86400 seconds	600
Use time synchronization	Enables or disables clock synchronization. Values: No, Yes	Yes
Application timeout	DNP3 application layer answer timeout Range of values: 0..255 seconds	10 seconds
Class 0 pooling	Period of class 0 data pooling 0 – no pooling Range of values: 0..3600 seconds	1800 seconds
Application layer name	Application layer name. For example: “Application layer”.	New Application layer name
Enabled on start	Enables or disables application layer on start. Values: No, Yes	Yes

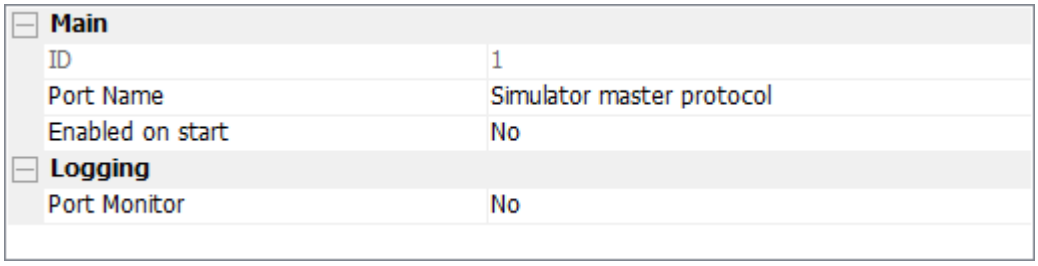
4.10.8.3 Points

Refer to the IEC-101 paragraph “Points”. (The configuration is very similar)

4.10.9 Simulator master configuration

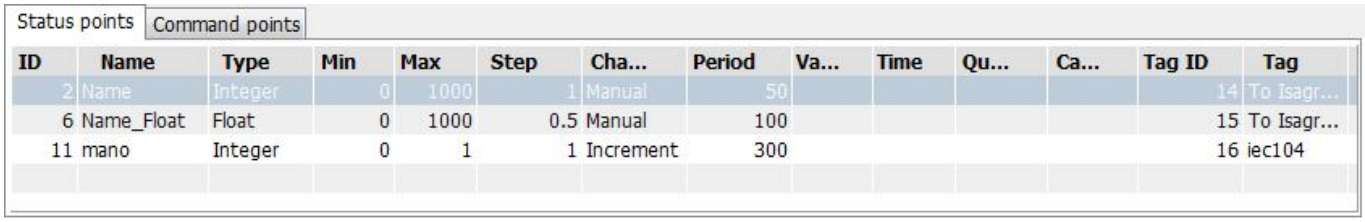
With simulator interface you can simulate data points to upper level protocols. It is very useful in testing environment. You can use it to test SCADA system without IED devices.

4.10.9.1 Port parameters



Field name	Description	Default value
ID	For internal use only.	
Port name	Simulator port name. For example: “Simulator”.	New Simulator master
Enabled on start	Enables or disables port on start. Values: No, Yes	No
Port monitor	Show port monitor on system startup. Values: No, Yes	No

4.10.9.2 Points


Status points
Command points
ID Name Type Min Max Step Cha... Period Va... Time Qu... Ca... Tag ID Tag
2 Name Integer 0 1000 1 Manual 50 14 To Isagr...
6 Name_Float Float 0 1000 0.5 Manual 100 15 To Isagr...
11 mano Integer 0 1 1 Increment 300 16 iec104

Following figure shows Add new simulation point dialog window. You can specify some parameters like Name, Value type, Change type, Min value, Max value, Step, Change every.

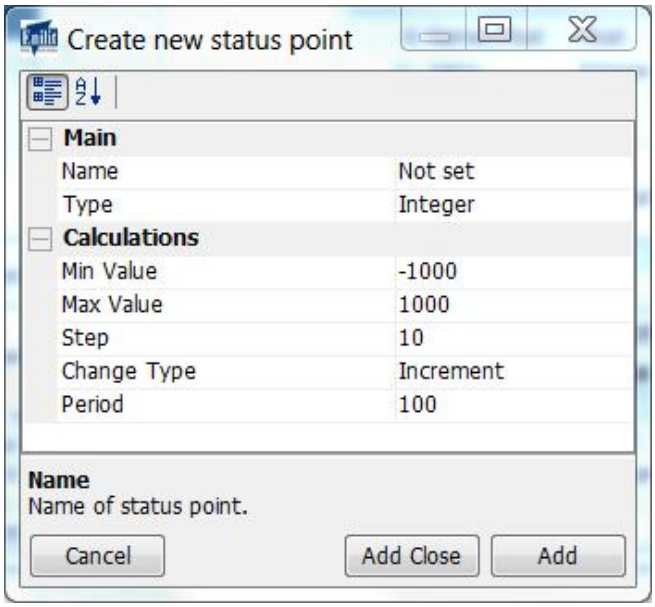


Figure 86. Add new simulation point

Field name	Description	Default value
Name	Name of status point. For example: “Data Point 1”.	Name
Type	Type of data point. Range of values: Integer, Float	Integer
Min value	Minimum value of simulation data point. Range of values: 0 … 16777215	0
Max value	Maximum value of simulation data point. Range of values: 0 … 16777215	1000
Step	Step size to change simulation data point between Min and Max values Range of values: 0 … 16777215	1
Change type	Data point simulation type. Range of values: Increment, Decrement, Random, Manual.	Increment
Change every	Cycle time of data point change. Range of values: 0 … 60000 milliseconds	100

If you have configured manual data point change type, you can change data point manually by entering Manual set value dialog from data point popup menu. Following figure shows this menu.

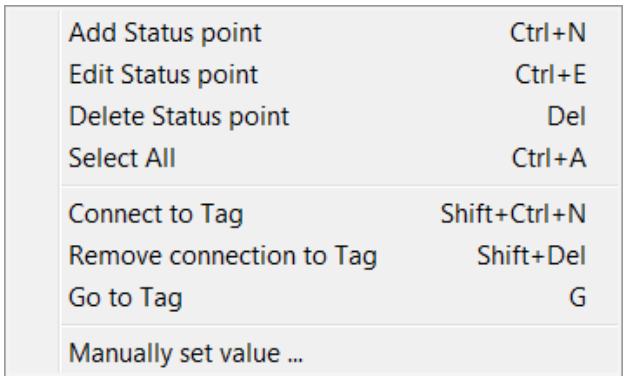

Add Status point Ctrl+N
Edit Status point Ctrl+E
Delete Status point Del
Select All Ctrl+A
Connect to Tag Shift+Ctrl+N
Remove connection to Tag Shift+Del
Go to Tag G
Manually set value ...

Figure 87. Simulator data point popup menu

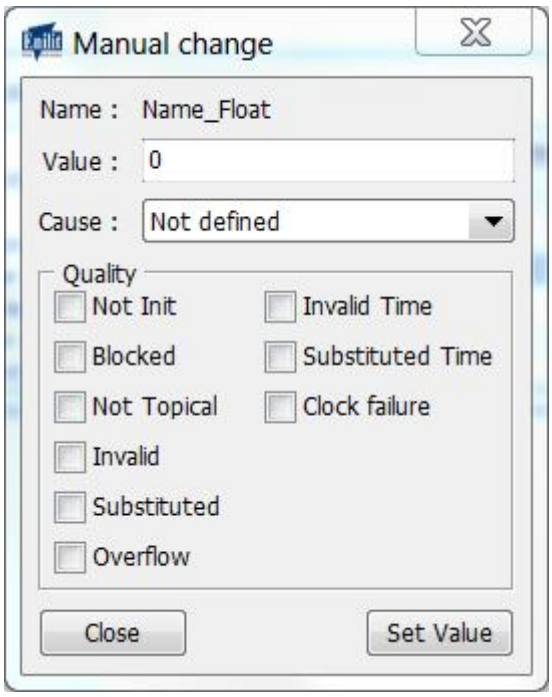


Figure 88. Manual change type dialog

With manual change type you can simulate also Cause of transmission and Quality of data point.

Cause of transmission can be: Not defined, Initialize, Periodic, Background, Spontaneous, General Interrogation, Requested, Control local, Control remote, Disconnected source, Disabled source, Deleted source, Test mode, Calculated.

Quality values can be in the range: Not Init, Blocked, Not Topical, Invalid, Substituted, Overflow, Invalid Time, Substituted time, Clock failure.

4.10.10 RP-570 configuration

4.10.10.1 Communication port parameters

Field name	Description	Default value
Baud rate	Serial port baud rate. Range of values: 110 … 921600	19200
Com port	Communication port number. For example with default value will be used COM1. Range of values: 1 … 255	1
Data bits	Serial port data bits. Values: 7, 8 bits	8
Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	None
Stop bits	Serial port stop bits. Values: 1, 1.5, 2 bits	1
Port enabled	Port enabled on system startup. Values: No, Yes	No
Port name	Name of the port and protocol. For example: “COM1 RP-570 master”	“New Communication Port”

4.10.10.2 Data link layer parameters

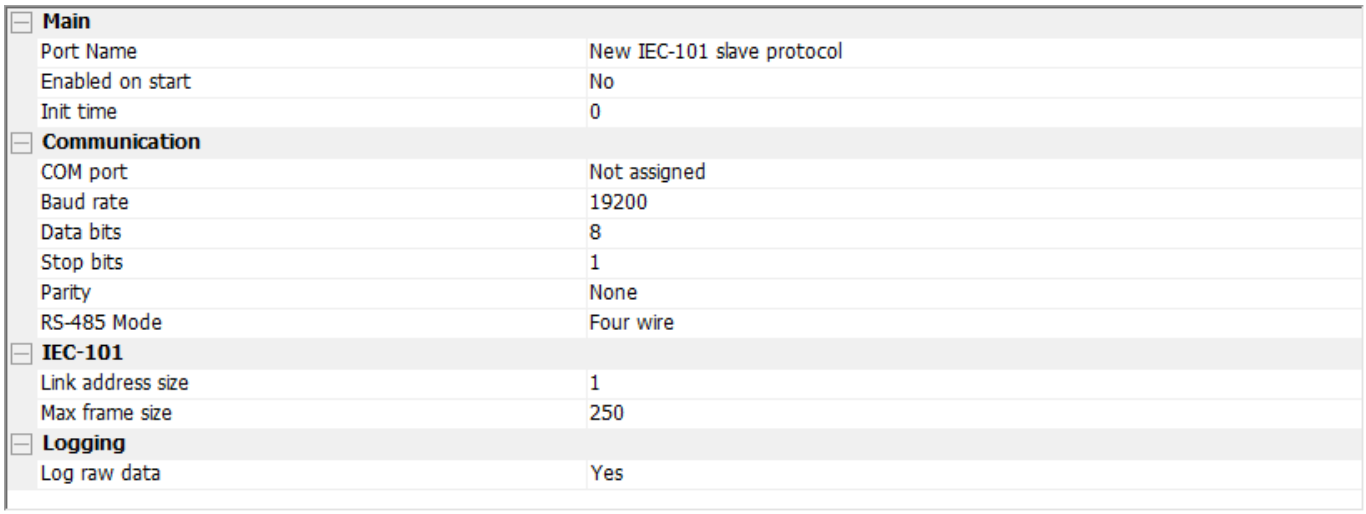
Field name	Description	Default value
RTU Number	RTU Number or address Range of values: 1 … 254	1
Max frame size	Maximum frame length Range of values: 50 … 255 bytes	255
Answer timeout	Wait timeout of response from controlled device. Range of values: 50 … 30000 milliseconds	500
Ask data every	This parameter is important if you have more than one controlled device on one communication port. You can use it for raring data requests to the desirable device. Range of values: 1 … 10	1

Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 10	5
No link cycle	This parameter is important if there is no link to the controlled device. With default value it sends requests every tenth cycle. Range of values: 1 … 10	10
Data link name	Data link layer name. For example: “Feeder 1”.	New Data Link layer
Enabled on start	Enables or disables data link on start. Values: No, Yes	Yes

4.11 Slave protocols

4.11.1 IEC 60870-5-101 protocol configuration

4.11.1.1 Communication port parameters

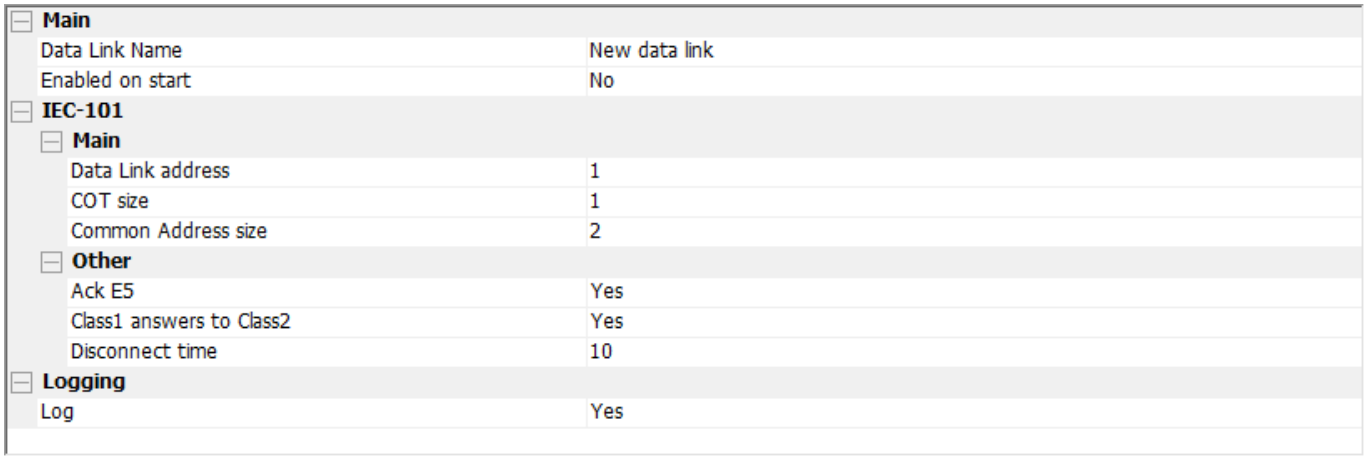


Main	
Port Name	New IEC-101 slave protocol
Enabled on start	No
Init time	0
Communication	
COM port	Not assigned
Baud rate	19200
Data bits	8
Stop bits	1
Parity	None
RS-485 Mode	Four wire
IEC-101	
Link address size	1
Max frame size	250
Logging	
Log raw data	Yes

Field name	Description	Default value
Port Name	Name of the port and protocol. For example: “COM3 IEC-101 slave”	“New IEC_101 slave protocol”
Enabled on start	Port enabled on system startup. Values: No, Yes	No
Init time	Protocol initialization time on startup. During this time no events will be generated. Range of values: 0 … 600 seconds	0
Com port	Communication port number. Range of values: COM 1 … COM 255	Not assigned
Baud rate	Serial port baud rate. Range of values: 110 … 921600	19200
Data bits	Serial port data bits. Values: 7, 8	8
Stop bits	Serial port stop bits. Values: 1, 1.5, 2	1
Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	None

RS-485 Mode	If used two wires mirrored data check should be used. If serial port is RS-232, parameter is not important. Values: Two wires, Four wires.	Four wires
Link Address size	Data link address size. Range of values: 0 … 2 bytes	1
Max frame size	Maximum frame length Range of values: 40 … 255 bytes	250
Log raw data	Log raw communication data. Values: No, Yes	Yes

4.11.1.2 Data link layer parameters



Field name	Description	Default value
Data Link Name	Data link layer name. For example: “Measurements data controller”.	New Data Link
Enabled on start	Enables or disables data link on start. Values: No, Yes	No
Data link address	Data link address Range of values: 1 … 65534 (if Data link addr. length is set to 2), 1 … 254 (if Data link address length is set to 1), If Data link address length is set to 0, this parameter is not used.	1
COT size	Cause of transmission size. Range of values: 1 … 2 bytes	1

Common address size	Common address size. Range of values: 1 … 2 bytes	2
Ack E5	Enables or disables E5 response to controlling device. Values: No, Yes	Yes
Class1 answers to Class2	Enables or disables Class1 data response to Class2 requests. Values: No, Yes	Yes
Disconnect time	If data link layer doesn't get requests for more than particular time, it will be considered as disconnected. Values: 0 … 60 seconds	10
Log	Log data link layers. Values: No, Yes	Yes

4.11.1.3 Application layer parameters

Main	
Appl Name	New application layer
Enabled on start	No
IEC-101	
Main	
Common address	1
Object address size	3
Object address structure	Unstructured
Max Frame size	250
End of init	Yes
Interrogation	
Interrogation command response	No
Commands	
Time differnce	10000
Clock	
Allow syncronization	No
UTC	Yes
Time differnce	1000
Day of Week	Yes
Summer time	Yes
Hour change	No
Cycles	
Periodic	10
Background	60
Buffers	
Event buffer Class1 size	1000
Event buffer Class1 overflow	Remove first
Overflow IOA Class1	0
Event buffer Class2 size	1000
Event buffer Class2 overflow	Remove first
Overflow IOA Class2	0
Other	
SQ	Yes
Logging	
Log DUI	Yes
Log IO	Yes

Field name	Description	Default value
Appl Name	Application layer name. For example: “SCADA 1”.	New application layer
Enabled on start	Enables or disables data link on start. Values: No, Yes	No
Common address	Common address of data unit. Range of values: 1 … 254	1
Object address size	Size of information object address field. Range of values: 1 … 3	3
Object address structure	Object address structure shows in what format information object address is entered in configuration.	Unstructured

	Range of values: Unstructured, Structured 8.8.8,Structured 8.16, Structured 16.8,Structured 8.8	
Max Frame size	Maximum frame size. Range of values: 40 … 255	250
End of init	Enables or disables station initialization frame transmission to controlled station. Values: No, Yes	Yes
Interrogation command response	How to behave if received general interrogation command request, but general interrogation already is going. No – general interrogation is restarted. Values: No, Yes	No
Commands Time difference	Time difference to discard command execution. Range of values: 10 … 10000 milliseconds	10000
Allow synchronization	Allows clock synchronization from controlled station. Values: No, Yes	No
UTC	Time synchronization with UTC timestamp. Values: No, Yes	Yes
Time difference	Time difference to synchronize internal RTU clock. Range of values: 20 … 10000 milliseconds	1000
Day of Week	In responses with timestamp use Day of Week bit. Values: No, Yes	Yes
Summer time	In responses with timestamp use Summer time bit. Values: No, Yes	Yes
Hour change	Transmit spontaneous clock synchronization command on hour change. It is only used for events with CP24Time2a timestamp. Values: No, Yes	No

Periodic	Cycle time of data marked with Cyclic/Periodic COT. Range of values: 10 … 10000 seconds	10
Background	Cycle time of data marked with Background COT. Range of values: 10 … 10000 seconds	60
Event buffer Class1 size	Spontaneous Events buffer of Class 1 size. Change has only take effect after system restart. Range of values: 10 … 10000 events	1000
Event buffer class1 overflow	If the buffer of class 1 events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
Overflow IOA Class1	Overflow information object address for Class1. On buffer overflow this IOA will be set to 1 and when there is free places in buffer it will be set to 0. When it changes to 0, controlling device should initiate general interrogation.	0 – not used
Event buffer Class2 size	Spontaneous Events buffer of Class 2 size. Change has only take effect after system restart. Range of values: 10 … 10000 events	1000
Event buffer class2 overflow	If the buffer of class 2 events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
Overflow IOA Class2	Overflow information object address for Class2. On buffer overflow this IOA will be set to 1 and when there is free places in buffer it will be set to	0 – not used

	0. When it changes to 0, controlling device should initiate general interrogation.	
SQ	Use SQ bit. Recommended to use only if most part of information object addresses are incremented by one. Values: No, Yes	Yes
Log DUI	Log data unit identifiers. Values: No, Yes	Yes
Log IO	Log information objects. Values: No, Yes	Yes

4.11.1.4 Points

Data points and command points in monitoring direction are freely configurable. All the configured data and command points you will connect to the tag, which you have already connected to the data sources.

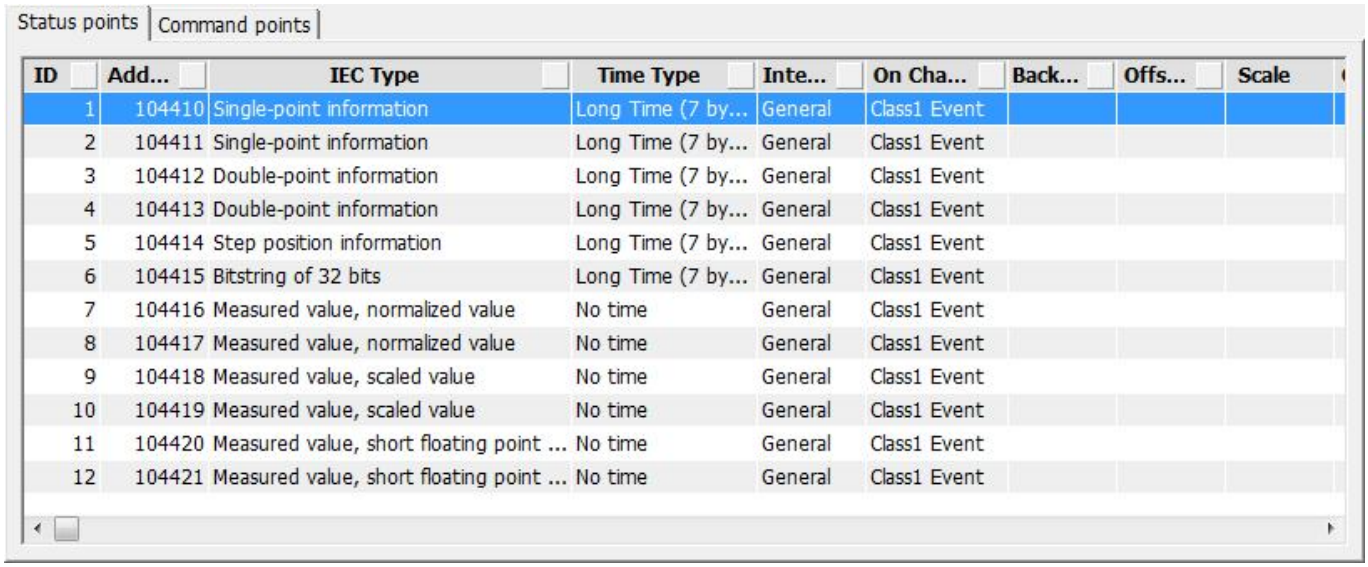

Status points
Command points
ID
Add...
IEC Type
Time Type
Inte...
On Cha...
Back...
Offs...
Scale
1 104410 Single-point information Long Time (7 by... General Class1 Event
2 104411 Single-point information Long Time (7 by... General Class1 Event
3 104412 Double-point information Long Time (7 by... General Class1 Event
4 104413 Double-point information Long Time (7 by... General Class1 Event
5 104414 Step position information Long Time (7 by... General Class1 Event
6 104415 Bitstring of 32 bits Long Time (7 by... General Class1 Event
7 104416 Measured value, normalized value No time General Class1 Event
8 104417 Measured value, normalized value No time General Class1 Event
9 104418 Measured value, scaled value No time General Class1 Event
10 104419 Measured value, scaled value No time General Class1 Event
11 104420 Measured value, short floating point ... No time General Class1 Event
12 104421 Measured value, short floating point ... No time General Class1 Event

Figure 89. Data points for IEC 60870-5-101 slave

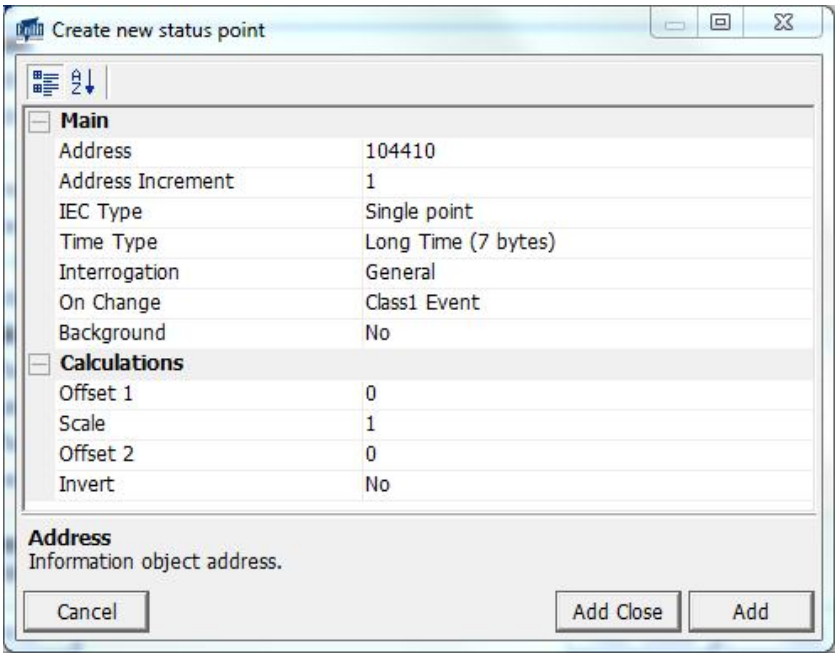


Figure 90. Add new data points dialog for IEC 60870-5-101 slave

Field name	Description	Default value
Address	Here, the information address can be specified. Range of information address depends from Application layer parameter Information object address length. Range of values: 0 … 16777215	1
Address Increment	After adding new data point address will be automatically incremented by set value. It is used only for configuration.	1
IEC Type	IEC 60870-5-101 data type. Values: Single point Double point Step position Bit string of 32 bits Measured value, normalized value Measured value, scaled value Measured value, short floating point value	Single Point
Time type	Timestamp of data point. Range of values: No time,	No time

	Short time (3 bytes) Long time (7 bytes)	
Interrogation	Assign data point to the specific interrogation group. Range of values: General, Group1, Group2, Group3, Group4, Group5, Group6, Group7, Group8, Group9, Group10, Group11, Group12, Group13, Group14, Group15, Group16.	General
On change	You can specify data point class or cause of transmission. If you choose to be Class1 Event or Class2 Event, data point will be marked with Spontaneous cause of transmission. Range of values: Class1 Event, Class1 Event, not buffered when no link, Class2 Event, Class2 Event, not buffered when no link, Send only on general interrogation request, Periodic.	Class1 Event
Value	Conversion of measurements. Value = (X + a) * b + c X – Value from slave device. a, b, c – free configurable variables.	No conversion
Invert	Inversion of signals Type 1 and Type 2. Values: No, Yes	No

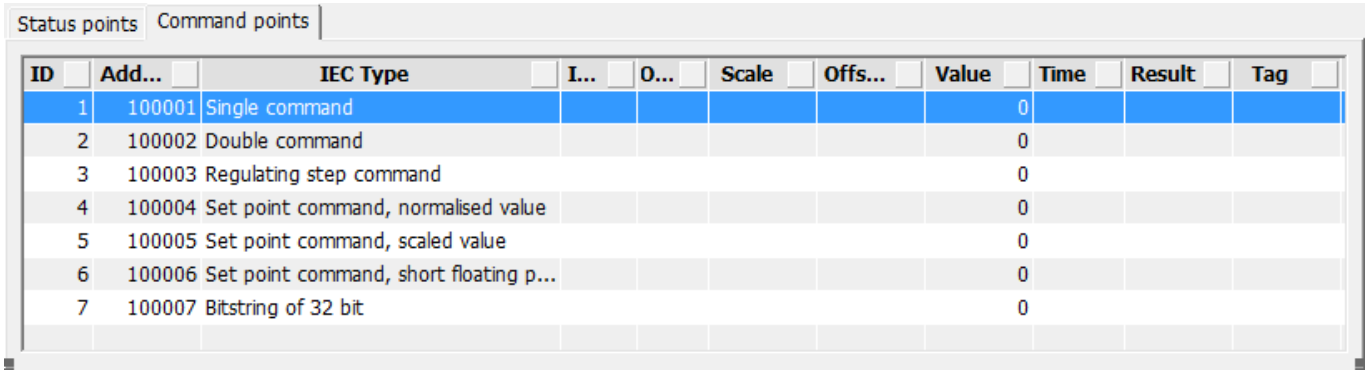


Figure 91. Command points for IEC 60870-5-101 slave

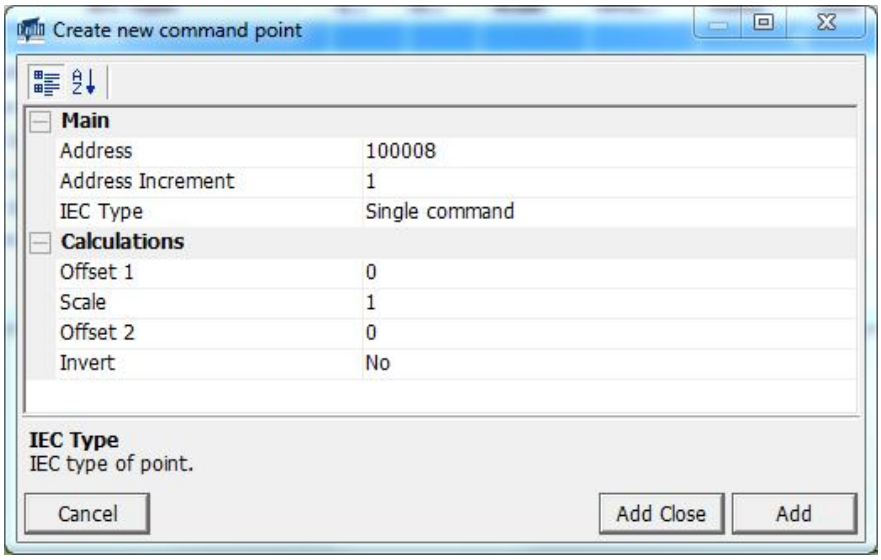


Figure 92. Add new command points dialog for IEC 60870-5-101 slave

Field name	Description	Default value
Information address	Here, the information address can be specified. Range of information address depends from Application layer parameter Information object address length. Range of values: 0 … 16777215	1
IEC Type	IEC 60870-5-101 command type. Values: Single command Double command Regulating step command Setpoint normalized command Setpoint scaled command Setpoint short float command Bitstring command	Single Command
Value	Conversion of commands. Value = (X + a) * b + c X – Value from slave device. a, b, c – free configurable variables.	No conversion
Invert	Inversion of commands. Values: No, Yes	No

You can select some data points and then press Ctrl+Shift+N to connect all selected data points to the tags in a row. If tag icon is grayed out, it is not possible to connect to slave status point or command point. It means if you have to choose Status point in slave protocol, it is possible to connect only to status tag. And if you have to choose Command point in slave protocol, it is possible to connect only to command tag.

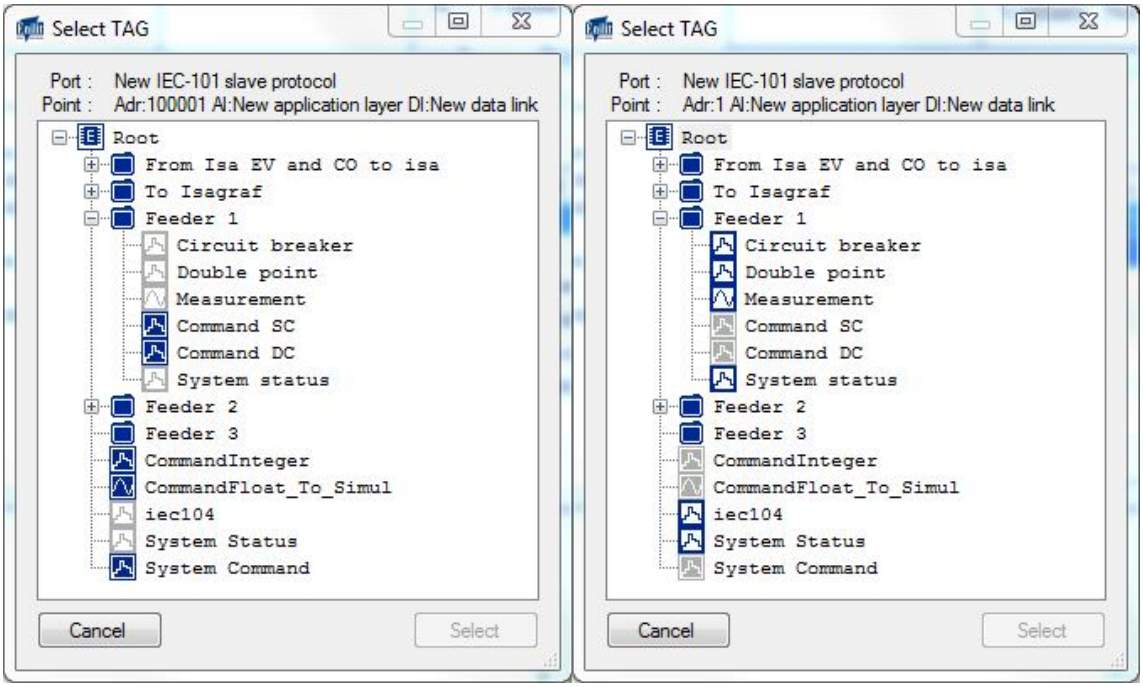


Figure 93. Status point or command point connection to tag dialog box

4.11.2 IEC 60870-5-104 protocol configuration

4.11.2.1 Communication port parameters

Main	
Port Name	New IEC-104 slave protocol
Enabled on start	Yes
Init time	0
Communication	
Ethernet port	All ETH
IP port	2404
TCP Keep Alive	10000
TCP No delay	No
Logging	
Log RAW	Yes
Log IP	Yes

Field name	Description	Default value
Port Name	Port name. For example: “IEC-104 slave”	New IEC-104 slave protocol
Enabled on start	Enables or disables communication port on start. Values: No, Yes	Yes

Init time	Protocol initialization time on startup. During this time no events will be generated Range of values: 1 … 60	0
Ethernet port	Which Ethernet port to use to create server. Values: All ETH, ETH 1, ETH 2, ETH 3.	All ETH
IP Port	TCP port Range of values: 1 … 65535	2404
TCP Keep Alive	Checks the connected socket and determines whether the connection is still up and running or if it has broken. Range of values: 1 … 2147483647 milliseconds 0 – disabled.	10000
TCP No delay	Controls TCP packet batching. Values: No, Yes	No
Log RAW	Enables to log RAW. Values: No, Yes	Yes
Log IP	Enables to log IP. Values: No, Yes	Yes

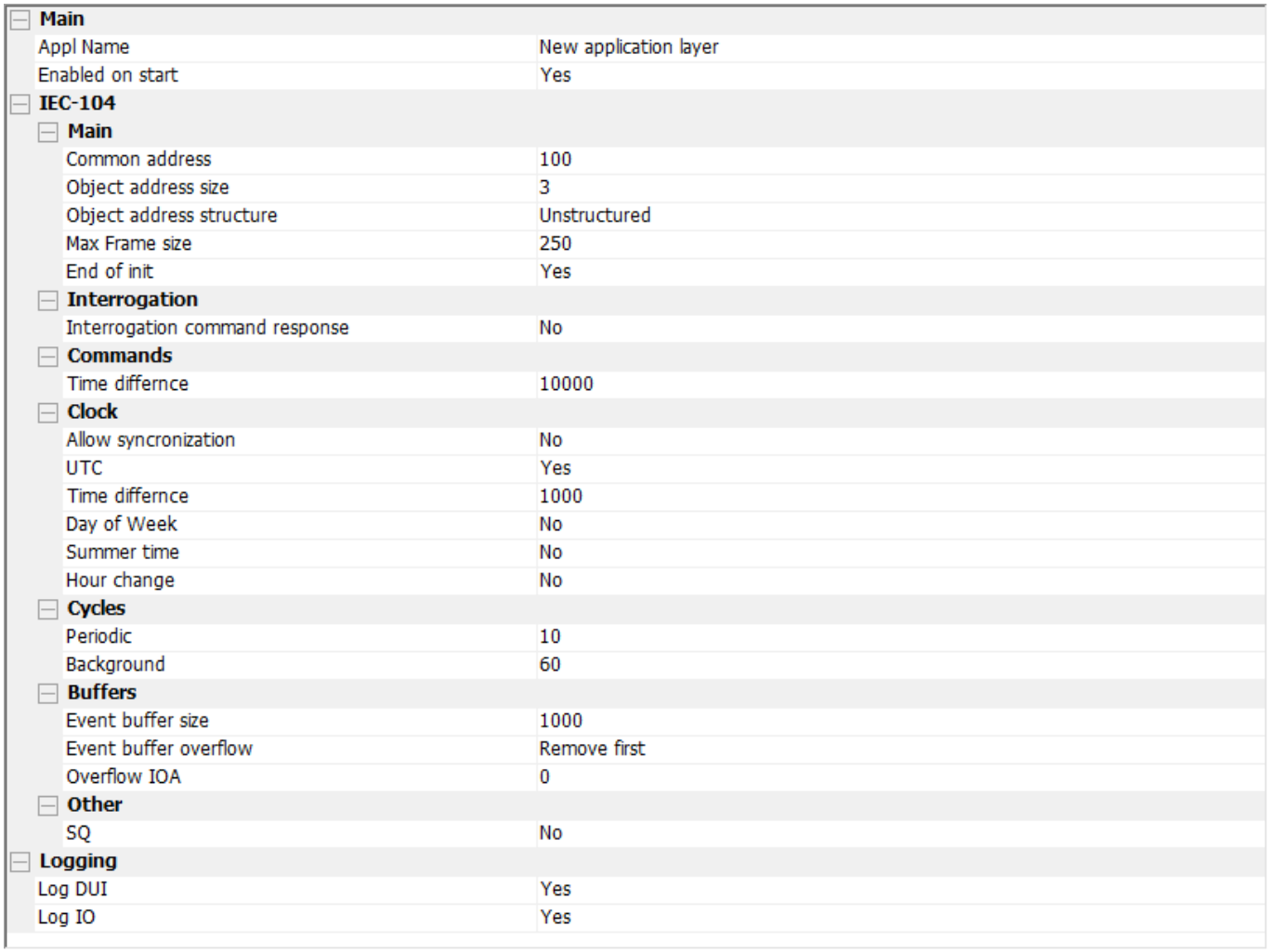
4.11.2.2 Client parameters

Main	
Client Name	New IEC104 client
Enabled on start	Yes
IEC-104	
Time Outs	
T1	15
T2	10
T3	30
k	12
w	8
Sizes	
Common address size	2
Cause of transmisition size	2
Allowed clients	
IP 1	127.0.0.1
IP 2	192.168.1.63
IP 3	192.168.1.34
IP 4	
IP 5	
IP 6	
IP 7	
IP 8	
IP 9	
Logging	
Log APCI	Yes

Field name	Description	Default value
Client Name	Client name. For example: “IEC-104 client”	New IEC104 client
Enabled on start	Enables or disables client on start. Values: No, Yes	Yes
T1	Acknowledgement time-out 1. Range of values: 1...600 seconds	15
T2	Acknowledgement time-out 2. Range of values: 1...600 seconds	10
T3	Connection test timeout. Range of values: 1...600 seconds	30
k	Maximum number of unacknowledged I format ADPU’s. Range of values: 1...32,767	12
w	After how many I frame APDU’s acknowledgment is needed. Range of values: 1...32,767	8
Common address size	Common address size. Values: 1, 2	2

Cause of transmission size	Cause of transmission size. Values: 1, 2	2
IP 1 … IP 9	Access list of clients IPs. Range of values: xxx.xxx.xxx.xxx	127.0.0.1
Log ACPI	Enables to log ACPI header values. Values: No, Yes	Yes

4.11.2.3 Application layer parameters



Field name	Description	Default value
Appl Name	Application layer name. For example: “SCADA 1”.	New application layer
Enabled on start	Enables or disables data link on start. Values: No, Yes	No
Common address	Common address of data unit. Range of values: 1 … 254	1

Object address size	Size of information object address field Range of values: 1 … 3	3
Object address structure	Object address structure shows in what format information object address is entered in configuration. Range of values: Unstructured, Structured 8.8.8,Structured 8.16, Structured 16.8,Structured 8.8	Unstructured
Max Frame size	Maximum frame size. Range of values: 40 … 255	250
End of init	Enables or disables station initialization frame transmission to controlled station. Values: No, Yes	Yes
Interrogation command response	How to behave if received general interrogation command request, but general interrogation already is going. No – general interrogation is restarted. Values: No, Yes	No
Commands Time difference	Time difference to discard command execution. Range of values: 10 … 10000 milliseconds	10000
Allow synchronization	Allows clock synchronization from controlled station. Values: No, Yes	No
UTC	Time synchronization with UTC timestamp. Values: No, Yes	Yes
Time difference	Time difference to synchronize internal RTU clock. Range of values: 20 … 10000 milliseconds	1000
Day of Week	In responses with timestamp use Day of Week bit. Values: No, Yes	Yes
Summer time	In responses with timestamp use Summer time bit. Values: No, Yes	Yes

Hour change	Transmit spontaneous clock synchronization command on hour change. It is only used for events with CP24Time2a timestamp. Values: No, Yes	No
Periodic	Cycle time of data marked with Cyclic/Periodic COT. Range of values: 10 … 10000 seconds	10
Background	Cycle time of data marked with Background COT. Range of values: 10 … 10000 seconds	60
Event buffer size	Spontaneous Events buffer size. Change has only take effect after system restart. Range of values: 10 … 10000 events	1000
Event buffer overflow	If the buffer of events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
Overflow IOA	Overflow information object address. On buffer overflow this IOA will be set to 1 and when there is free places in buffer it will be set to 0. When it changes to 0, controlling device should initiate general interrogation.	0 – not used
SQ	Use SQ bit. Recommended to use only if most part of information object addresses are incremented by one. Values: No, Yes	Yes
Log DUI	Log data unit identifiers. Values: No, Yes	Yes
Log IO	Log information objects. Values: No, Yes	Yes

4.11.2.4 Points

Status points | Command points

ID	Addr...	IEC Type	Time Type	Inte...	On C...	Back...	Offs...	Scale	Offs...
2	1	Single-point information	Short time (3 by...	General	Event				
5	55	Single-point information	No time	General	Event				
6	1000	Single-point information	Long Time (7 by...	General	Event				
7	1001	Single-point information	Long Time (7 by...	General	Event				
8	1002	Single-point information	Long Time (7 by...	General	Event				
9	1003	Single-point information	Long Time (7 by...	General	Event				
10	1004	Single-point information	Long Time (7 by...	General	Event				
11	1005	Double-point information	Long Time (7 by...	General	Event				
12	1006	Double-point information	Long Time (7 by...	General	Event				
13	1007	Step position information	Long Time (7 by...	General	Event				
14	1008	Measured value, normalized value	Long Time (7 by...	General	Event				
15	1009	Measured value, normalized value	Long Time (7 by...	General	Event				
16	1010	Measured value, scaled value	Long Time (7 by...	General	Event				
17	1011	Measured value, scaled value	Long Time (7 by...	General	Event				
18	1012	Measured value, short floating poi...	Long Time (7 by...	General	Event				
19	1013	Measured value, short floating poi...	Long Time (7 by...	General	Event				

Figure 94. IEC-60870-5-104 status points window

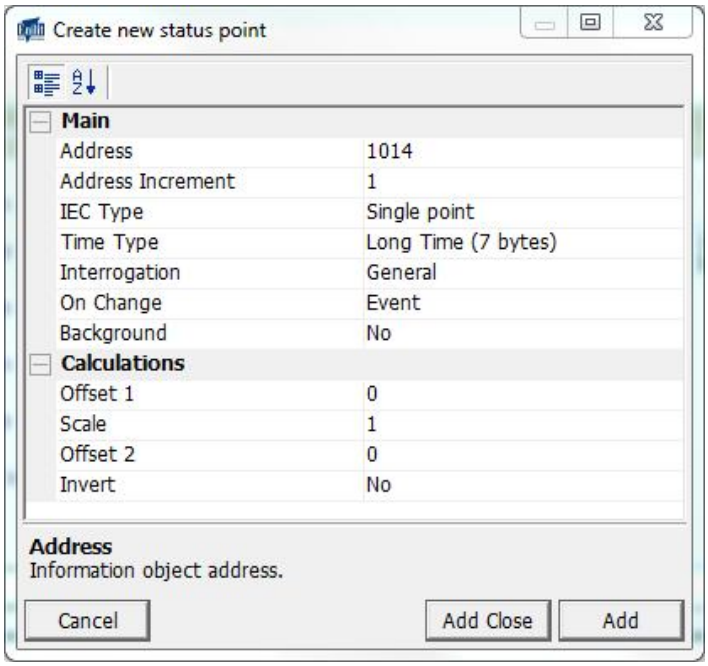


Figure 95. Add new data points dialog for IEC 60870-5-104 slave

Field name	Description	Default value
Address	Here, the information address can be specified. Range of information address depends from Application layer parameter Information object address length.	1

	Range of values: 0 … 16777215	
IEC Type	IEC 60870-5-104 data type. Values: Single point Double point Step position Bit string of 32 bits Measured value, normalized value Measured value, scaled value Measured value, short floating point value	Single Point
Time type	Timestamp of data point. Range of values: No time, Short time (3 bytes) Long time (7 bytes)	No time
Interrogation	Assign data point to the specific interrogation group. Range of values: General, Group1, Group2, Group3, Group4, Group5, Group6, Group7, Group8, Group9, Group10, Group11, Group12, Group13, Group14, Group15, Group16.	General
On change	You can specify data point class or cause of transmission. If you choose to be Class1 Event or Class2 Event, data point will be marked with Spontaneous cause of transmission. Range of values: Class1 Event, Class2 Event, Interrogation only, Periodic cycle, Background cycle.	Class1 Event
Calculations	Calculation of status item. New Value =	No conversion

	(Old value + Offset1) * Scale + Offset2	
Invert	Inversion of signals Type 1 and Type 2. Values: No, Yes	No

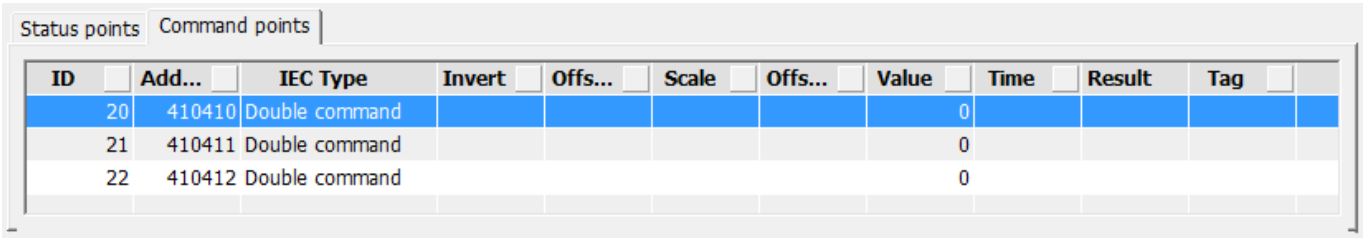


Figure 96. Command points for IEC 60870-5-104 slave

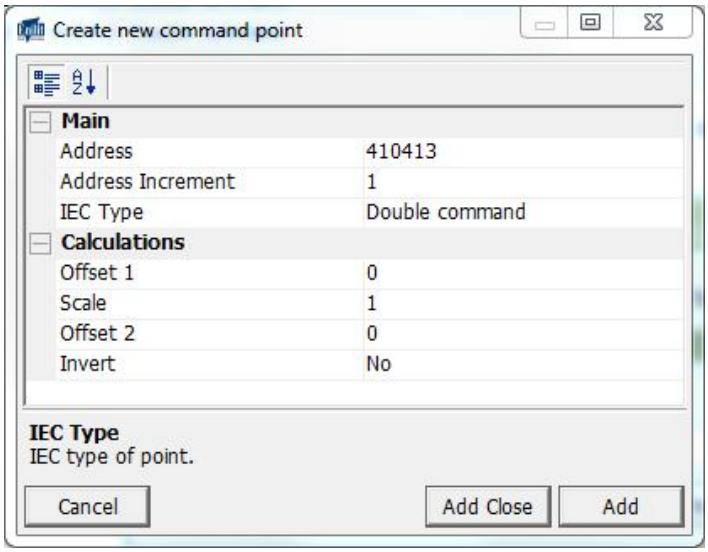


Figure 97. Add new command points dialog for IEC 60870-5-104 slave

Field name	Description	Default value
Information address	Here, the information address can be specified. Range of information address depends from Application layer parameter Information object address length. Range of values: 0 … 16777215	1
IEC Type	IEC 60870-5-104 command type. Values: Single command, Double command, Regulating step command, Setpoint normalized command, Setpoint scaled command,	Single Command

	Setpoint short float command, Bitstring command.	
Calculations	Calculation of status item. New Value = (Old value + Offset1) * Scale + Offset2	No conversion
Invert	Inversion of signals Type 1 and Type 2. Values: No, Yes	No

4.11.3 DNP3 serial slave configuration

4.11.3.1 Communication port parameters

Field name	Description	Default value
Baud rate	Serial port baud rate. Range of values: 110 … 921600	38400
Com port	Communication port number. For example with default value will be used COM1. Range of values: 1 … 255	1
Data bits	Serial port data bits. Values: 7, 8	8
Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	None
Stop bits	Serial port stop bits. Values: 1, 1.5, 2	1
Port enabled	Port enabled on system startup. Values: No, Yes	No
Port name	Name of the port and protocol. For example: “COM3 DNP3 slave”	“New Communication Port”

4.11.3.2 Data link layer parameters

Field name	Description	Default value
Master address	RTU’s master address. Range of values: 0 … 65535 bytes	1
Slave address	IED slave address. Range of values: 0 … 65535 bytes	2

Data link name	Data link layer name. For example: “Measurements data controller”.	New Data Link layer
Enabled on start	Enables or disables data link on start. Values: No, Yes	Yes

4.11.3.3 Application layer parameters

Field name	Description	Default value
On buffer class1 overflow	If the buffer of class 1 events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
On buffer class2 overflow	If the buffer of class 2 events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
On buffer class3 overflow	If the buffer of class 2 events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
Allow one command	Allow one command at the time. Values: No, Yes	No
Allowed synchronization	Allows clock synchronization from controlled station. Values: No, Yes	Yes

Time difference in milliseconds	Time difference to synchronize internal RTU clock. Range of values: 20 … 10000 milliseconds	1000
UTC	Time synchronization with UTC timestamp. Values: No, Yes	No
Spontaneous	Spontaneous messages enabled. Values: No, Yes	No
Spontaneous Class	Spontaneous Class messages class. Range of values: None Class 1 Class 2 Class 1&2 Class 3 Class 1 & 3 Class 2 & 3 Class 1 & 2 & 3	Class 1

4.11.3.4 Points

Refer to the IEC-101 paragraph “Points”. (The configuration is very similar)

4.11.4 DNP3 UDP/TCP/IP server configuration

4.11.4.1 Communication port parameters

Field name	Description	Default value
Ethernet port	Which Ethernet port to useto create server. Values: All ETH, ETH 1, ETH 2, ETH 3.	All ETH
IP Port	TCP port. Range of values: 1 … 65535	2404
TCP Keep Alive	Checks the connected socket and determines whether the connection is still up and running or if it has broken. Range of values: 1 … 2147483647 milliseconds 0 – disabled.	10000

TCP No delay	Controls TCP packet batching. Values: No, Yes	No
Log IP	Enables to log IP. Values: No, Yes	Yes
Log RAW	Enables to log RAW. Values: No, Yes	Yes
Init time	Protocol initialization time on startup. During this time no events will be generated Range of values: 1 … 60	0
Port enabled	Enables or disables communication port on start. Values: No, Yes	Yes
Port name	Port name. For example: “DNP3 slave”	New DNP3 server protocol

4.11.4.2 Application layer parameters

Field name	Description	Default value
On buffer class1 overflow	If the buffer of class 1 events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
On buffer class2 overflow	If the buffer of class 2 events overflows, with this parameter you can select which event to remove from queue. Range of values: Remove first, Remove last, Remove all.	Remove first
On buffer class3 overflow	If the buffer of class 2 events overflows, with this parameter you can select which event to remove from queue. Range of values:	Remove first

	Remove first, Remove last, Remove all.	
Allow one command	Allow one command at the time. Values: No, Yes	No
Allowed synchronization	Allows clock synchronization from controlled station. Values: No, Yes	Yes
Time difference in milliseconds	Time difference to synchronize internal RTU clock. Range of values: 20 … 10000 milliseconds	1000
UTC	Time synchronization with UTC timestamp. Values: No, Yes	No
Spontaneous	Spontaneous messages enabled. Values: No, Yes	No
Spontaneous Class	Spontaneous Class messages class. Range of values: None Class 1 Class 2 Class 1&2 Class 3 Class 1 & 3 Class 2 & 3 Class 1 & 2 & 3	Class 1

4.11.4.3 Points

Refer to the IEC-101 paragraph “Points”. (The configuration is very similar)

4.12 Tag manager

Tag manager is intermediate software part which connects status and command points from master to slave protocols or connects hardware tags to slave protocols. Either you can create here tags for internal logic or IsaGRAF programming. There you can create structure of substation for easier work with tags.

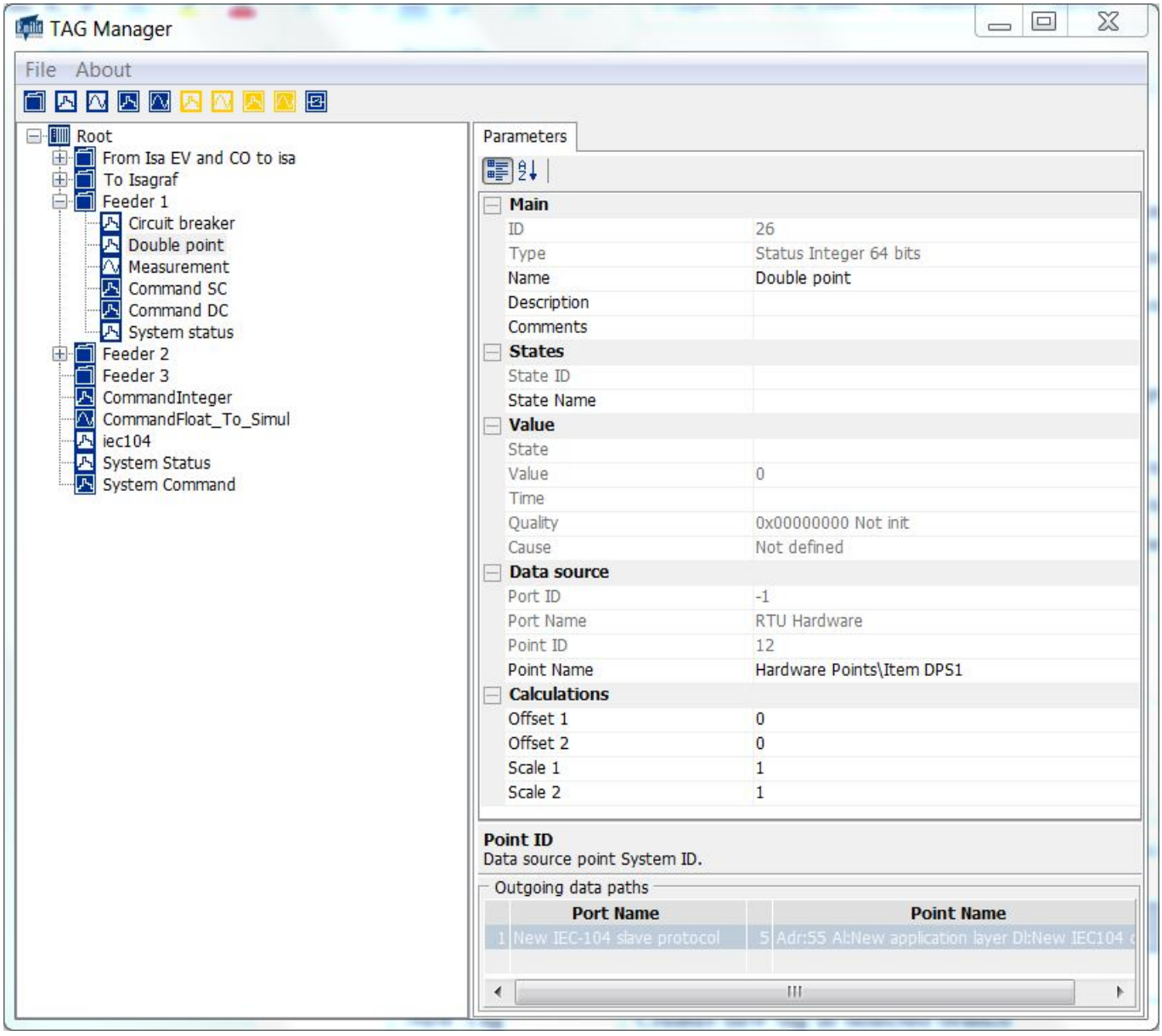


Figure 98. Main windows of Tag manager

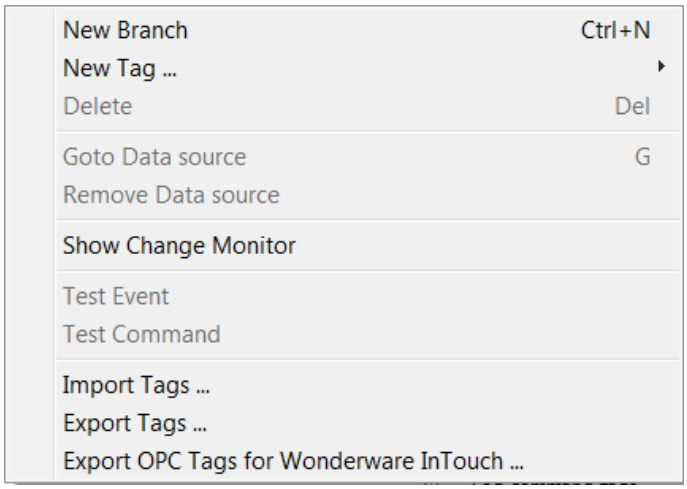


Figure 99. Active popup menu when tree branch is selected

Name	Description	Keyboard shortcut
New Branch	Creates new branch in the tree structure.	Ctrl+N
New Tag	Creates new tag in selected branch. You need to select from following types of Tags. New Status Integer 64 bits New Status Float 64 bits New Command Integer 64 bits New Command Float 64 bits New Manual Status Integer 64 bits New Manual Status Float 64 bits New Manual Command Integer 64 bits New Manual Command Float 64 bits New Mapped	
Delete	Deletes selected branch	Del
Goto Data source	If Tag is selected, you can reach the data source of Tag.	G
Remove Data source	Disconnect Data source from Tag.	
Show Change Monitor	Opens Change monitor window	
Test event	Test event with forced value and quality	
Test command	Test command with forced value and quality	
Import Tags	Import Tags from CSV file.	
Export Tags	Export Tags to CSV file.	
Export OPC Tags for Wonderware InTouch	Export Tags to CSV file for Wonderware InTouch FSGateway software.	

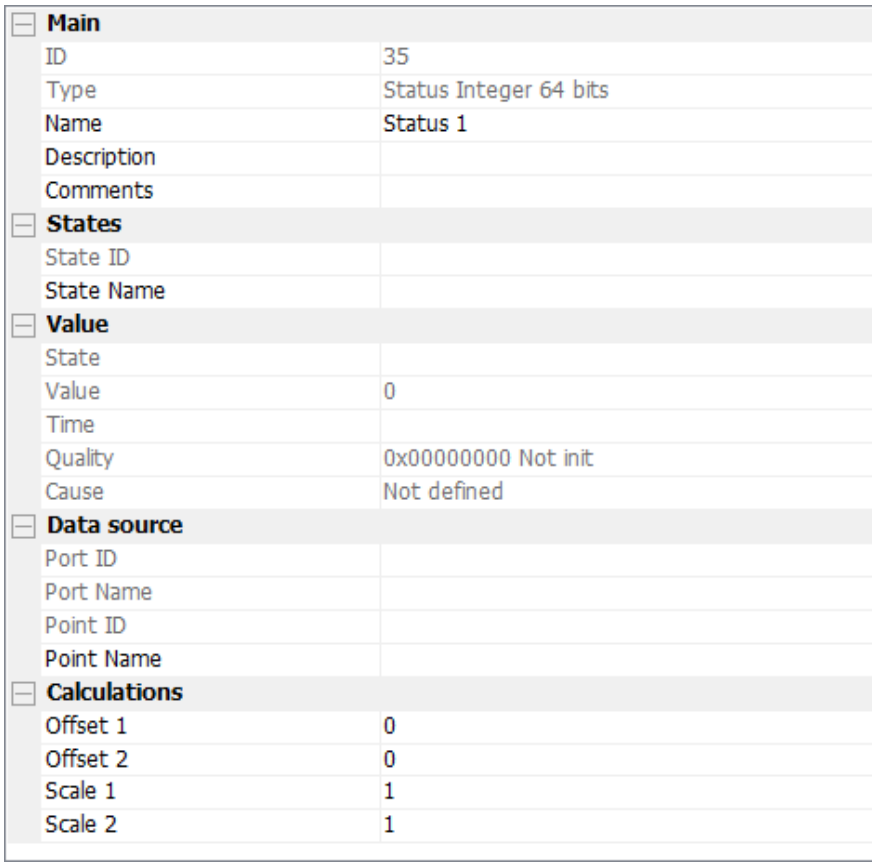


Figure 100. Tag edit window

Field name	Description	Default value
ID	ID number. Only for internal use.	Automatically increment value
Type	Tag data type. You can't edit this value. You must delete the tag and then create one new with the type you want. Values: Status Integer 64 bits, Status Float 64 bits, Command Integer 64 bits, Command Float 64 bits, Manual Status Integer 64 bits, Manual Status Float 64 bits, Manual Command Integer 64 bits, Manual Command Float 64 bits, Mapped Command.	
Name	Name of the tag.	Status 1
State ID	Tag states configuration ID.	Not connected
State Name	Tag states configuration Name.	Not connected
State	Real time state of Tag.	
Value	Real time value of Tag.	0
Time	Time of last change.	
Quality	Quality of last change.	0x00000000 Not init

Cause	Cause of transmission of last change.	Not defined
Port ID	Data source Port ID.	Not connected
Port Name	Data source Port Name.	Not connected
Point ID	Data source Point ID.	Not connected
Point Name	Data source Point Name.	Not connected
Offset 1	With those parameters you have possibility to change value, which you will take from the data source. NewValue=(OldValue+Offset1)*Scale+Offset2	0
Offset 2		0
Scale 1		1
Scale 2		1

Following picture shows Connect Tag to data source window. In the left side you will see structure which you have created in Master protocols. You can expand tree and find particular data point from master protocols points. To the tag you can connect only one data or command point.

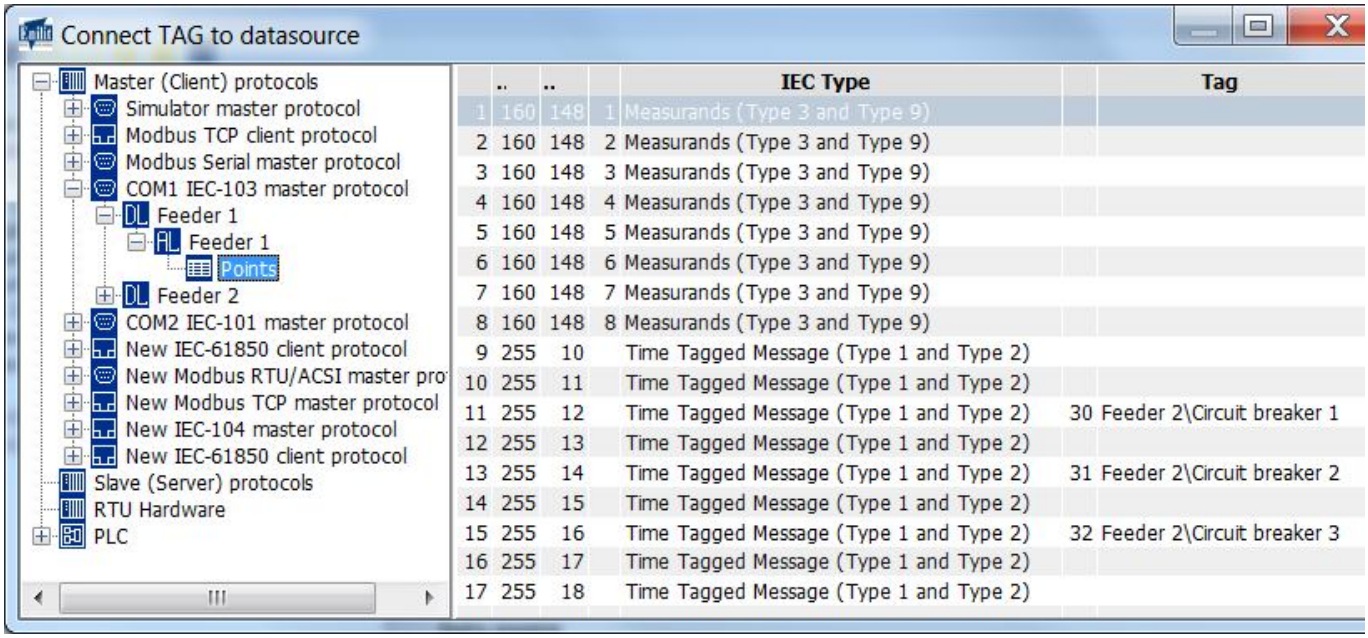

Connect TAG to datasource
Master (Client) protocols
Simulator master protocol
Modbus TCP client protocol
Modbus Serial master protocol
COM1 IEC-103 master protocol
Feeder 1
Feeder 1
Points
Feeder 2
COM2 IEC-101 master protocol
New IEC-61850 client protocol
New Modbus RTU/ACSI master pro
New Modbus TCP master protocol
New IEC-104 master protocol
New IEC-61850 client protocol
Slave (Server) protocols
RTU Hardware
PLC
.. .. IEC Type Tag
1 160 148 1 Measurands (Type 3 and Type 9)
2 160 148 2 Measurands (Type 3 and Type 9)
3 160 148 3 Measurands (Type 3 and Type 9)
4 160 148 4 Measurands (Type 3 and Type 9)
5 160 148 5 Measurands (Type 3 and Type 9)
6 160 148 6 Measurands (Type 3 and Type 9)
7 160 148 7 Measurands (Type 3 and Type 9)
8 160 148 8 Measurands (Type 3 and Type 9)
9 255 10 Time Tagged Message (Type 1 and Type 2)
10 255 11 Time Tagged Message (Type 1 and Type 2)
11 255 12 Time Tagged Message (Type 1 and Type 2) 30 Feeder 2\Circuit breaker 1
12 255 13 Time Tagged Message (Type 1 and Type 2)
13 255 14 Time Tagged Message (Type 1 and Type 2) 31 Feeder 2\Circuit breaker 2
14 255 15 Time Tagged Message (Type 1 and Type 2)
15 255 16 Time Tagged Message (Type 1 and Type 2) 32 Feeder 2\Circuit breaker 3
16 255 17 Time Tagged Message (Type 1 and Type 2)
17 255 18 Time Tagged Message (Type 1 and Type 2)

Figure 101. Connect tag to data source window

In the above picture right top corner you can choose primary data source. You can connect tags to Communication ports, RTU hardware points or PLC.

If you have connected Tag to the Data source and connected it also to Slave protocol, all the information regarding linkage you can see in the tag configuration of window. Also you can see here real-time value, state, timestamp, quality and cause of transmission of selected tag.

Value	
State	Norma
Value	0
Time	2015.02.11 13:59:50.323
Quality	Ok
Cause	Spontaneus

Figure 102. Signal monitoring

4.12.1 Tag states

Tag states configuration tool allows you to configure description to Tag Values. If it is configured, then Change Monitor you can see state of the signal or command, not only value. For example it is possible to configure description SET if Value=1 and RESET if Value=0.

Tag States have two types of states: Status State and Command State.

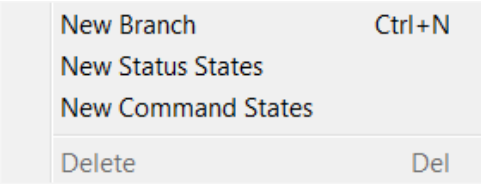


Figure 103. New Tag State window

Following picture shows initial Tag States window.

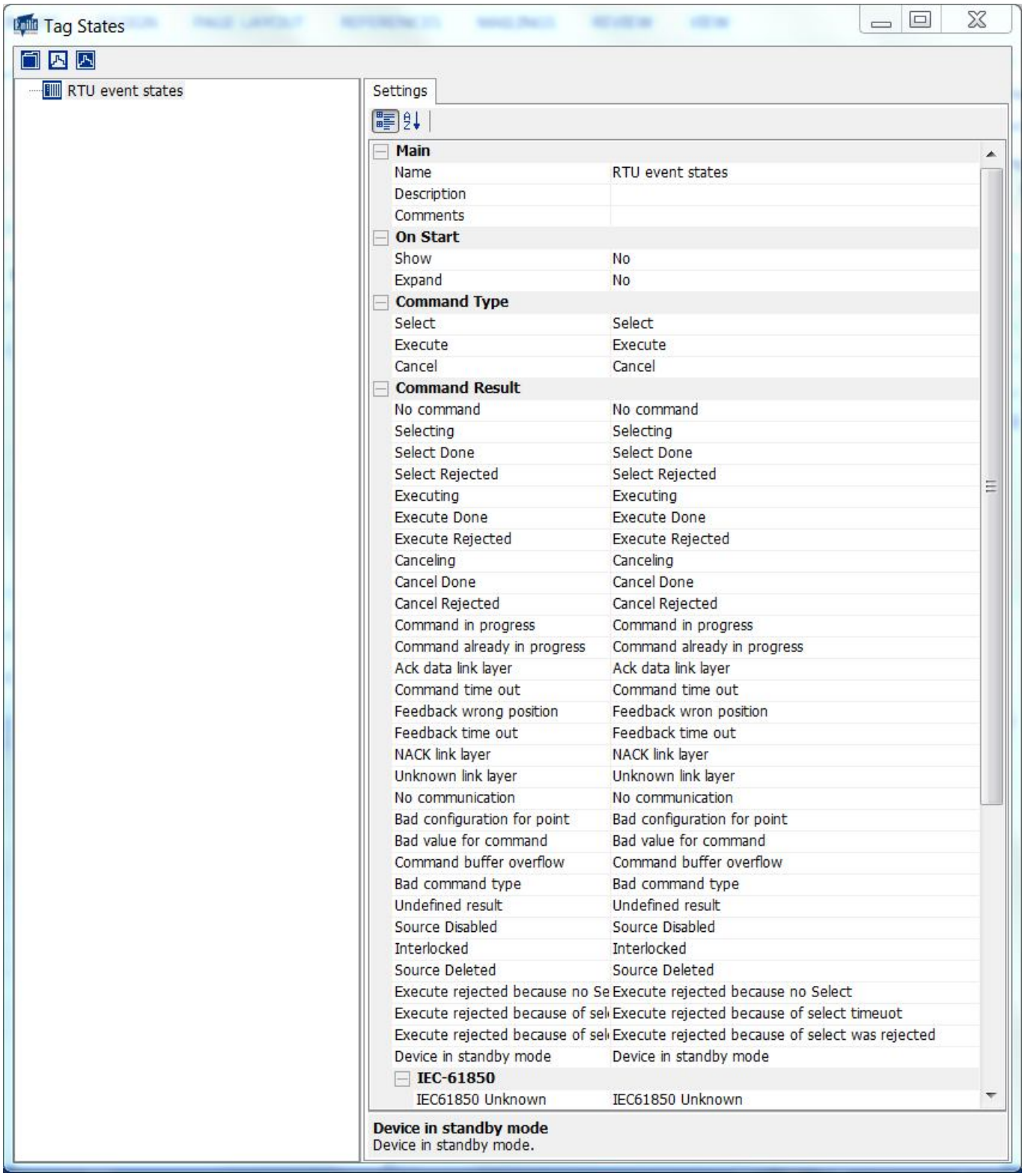


Figure 104. Initial Tag states window

When you start to configure state for status signal, it's needed to add with the priority 0, type irrelevant and quality Not topical with the value Yes. Then you add normal states, like Reset = 0 and Set = 1. Following picture show this configuration.

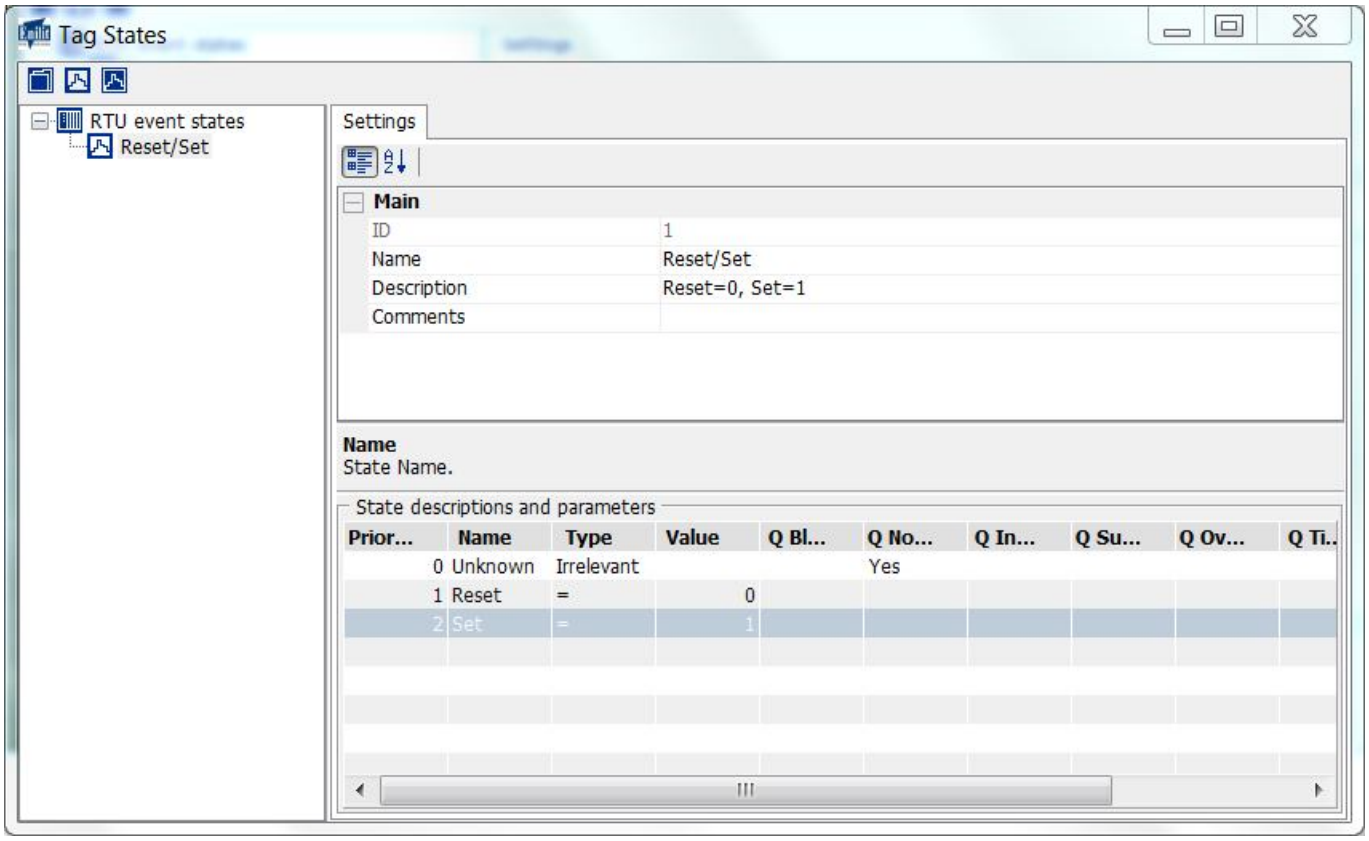


Figure 105. Configured status state

If the state is configured properly, then is possible to assign state to the signal or command in the Tag Manager window, like in the following picture.

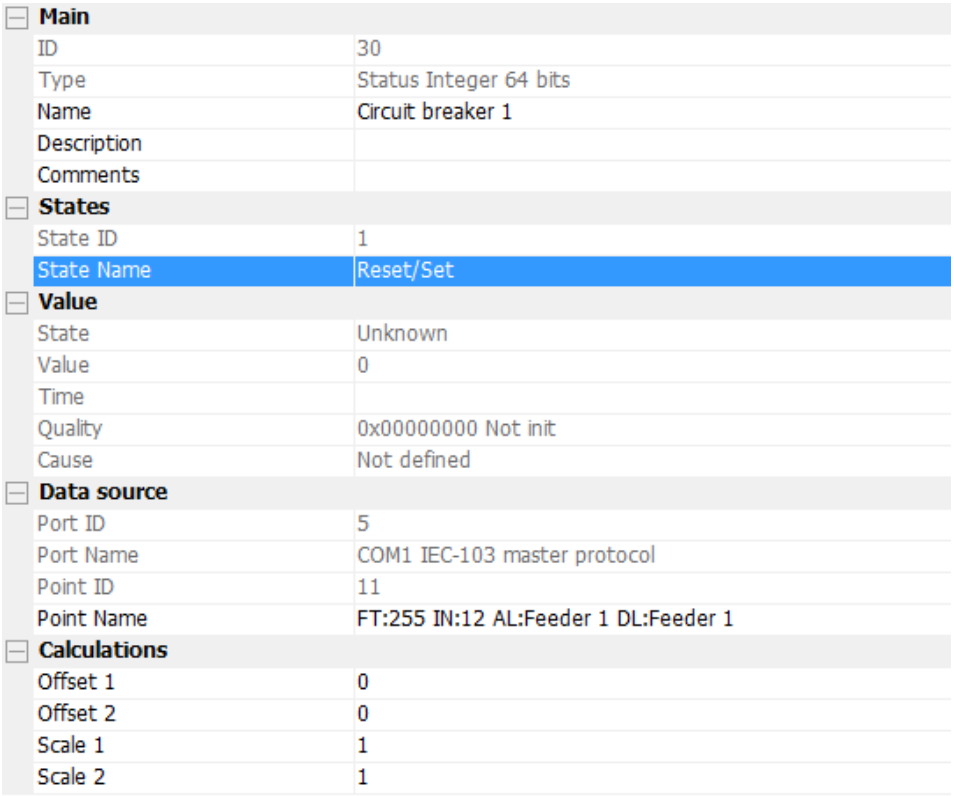


Figure 106. Configured Tag with assigned state

4.13 Internal programmable logic

Internal programmable logic are included in Enilit Configuration and Management Software by default. It gives you opportunity to use fast and simple programmable logic. To use it, it's needed to create Manual Status Integer 64 bits or Manual Status Float 64 bits tags. After creation of Manual tag, you will see Logic calculation area like in the following figure.

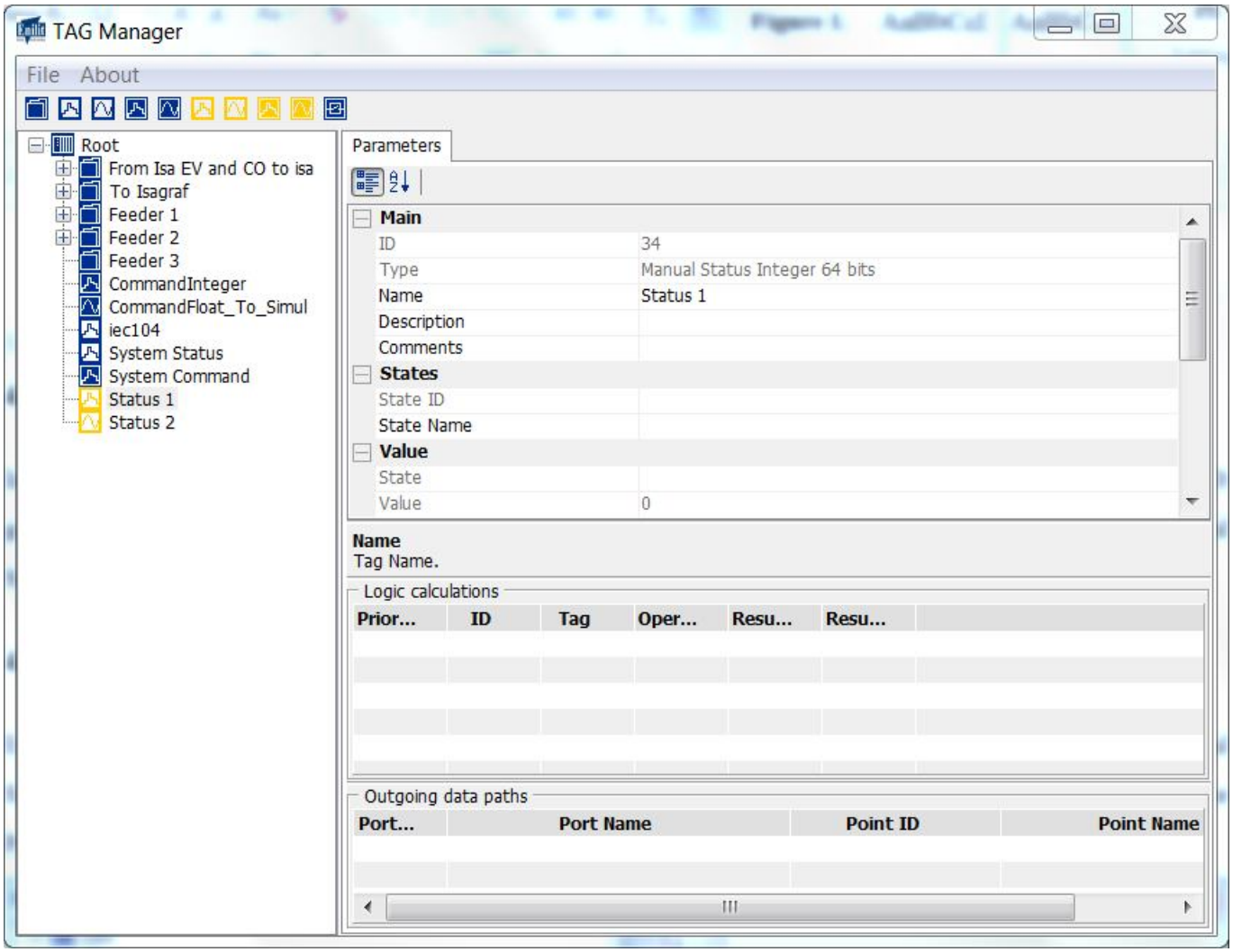


Figure 107. Manual Tag with Logic calculations area.

To create some logic, it is needed to add Logic calculations with the help of right mouse button on the Logic calculation window like in the following figure.

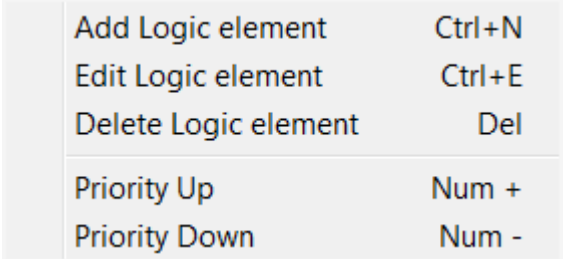


Figure 108. Logic calculation context menu.

If you click Add Logic element you will get following window:

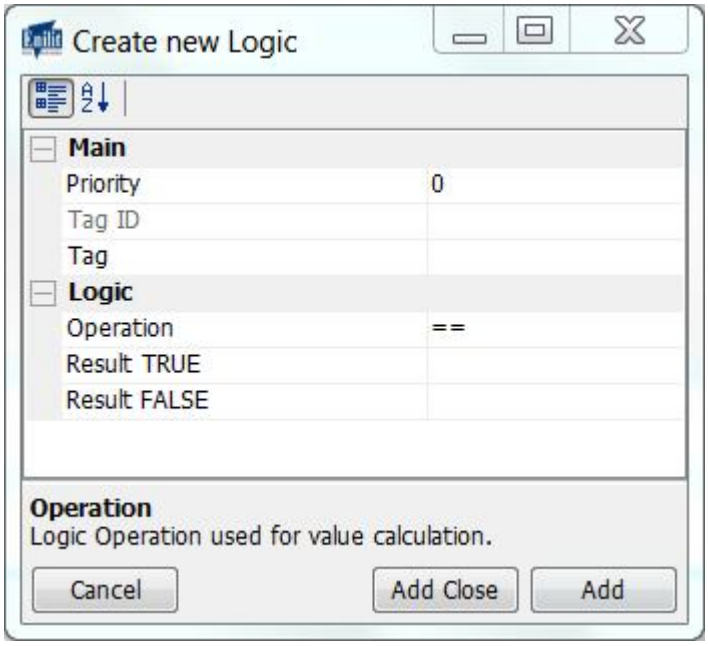


Figure 109. Add new Logic calculation.

It is needed to assign Tag from Tag Manager and Operation, then if Result is TRUE it will give value 1 to the next calculation, else if Result is FALSE it will output value 0 to the next calculation. With the parameters Result TRUE and Result FALSE it is possible to change result values to the next logic calculation. Operation can be one of: = (assign), == (equal), <> (not equal), < (less), <= (less or equal), > (more), >= (more or equal), OR, OR bits, AND, AND bits, XOR, XOR bits, + (addition), - (subtraction), *(multiplication), / (division).

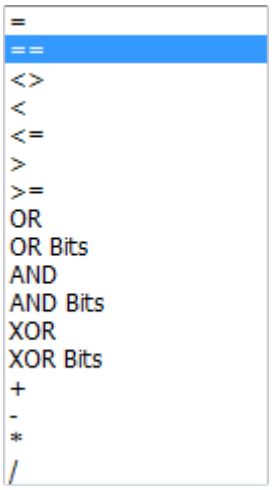


Figure 110. Integer type Logic operations.

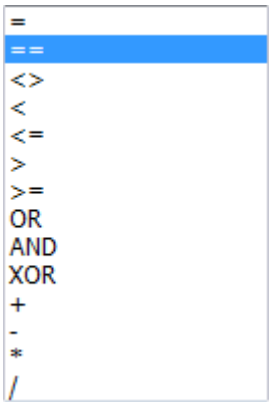


Figure 111. Float type Logic operations.

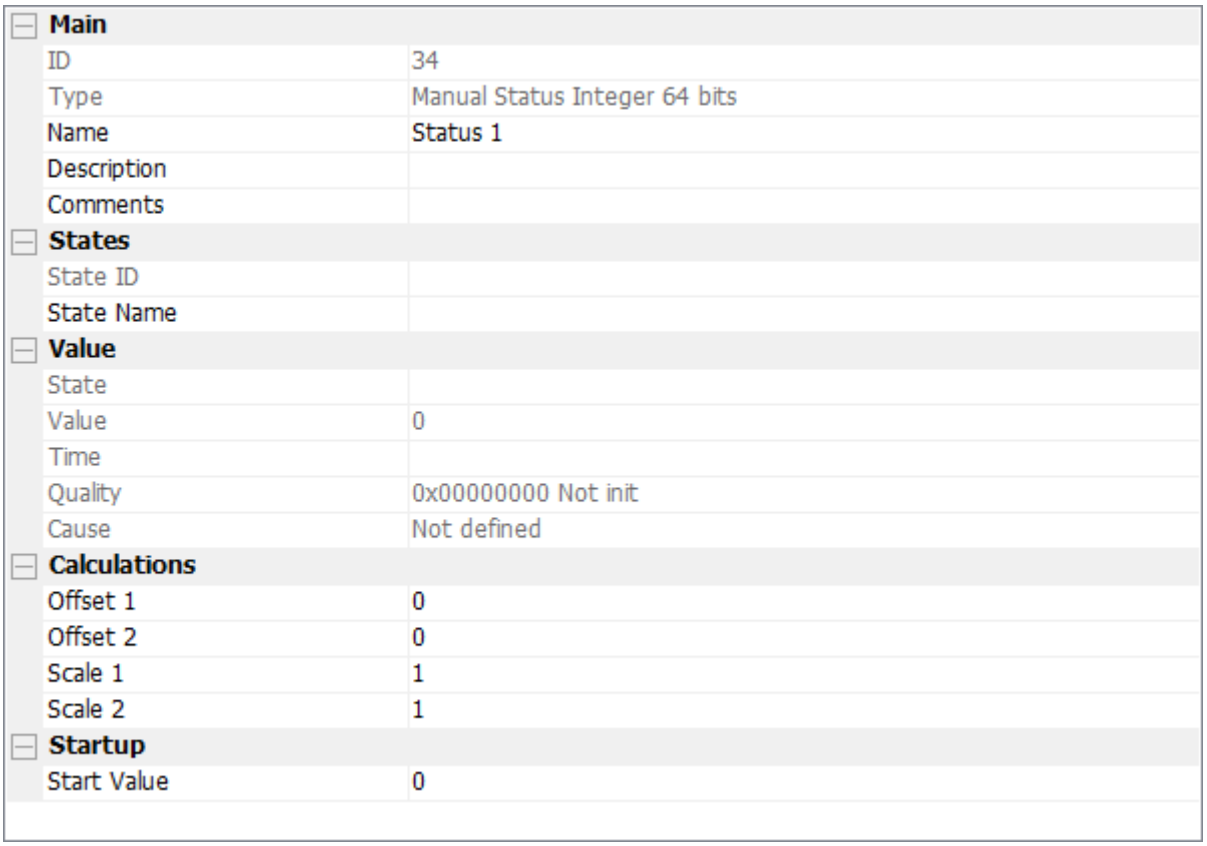


Figure 112. Integer type Manual tag parameters.

Field name	Description	Default value
ID	For internal use.	
Type	Type of Manual tag.	
Name	Name of Manual tag.	Status 1
Description	Description of Manual tag.	Empty
Comments	Additional user comments.	Empty
State ID	Tag state ID.	
State Name	Assigned Tag State name.	Not assigned

State	Actual state.	
Value	Actual value.	0
Time	Date/Time of last change.	
Quality	Actual quality.	0x00000000 Not init
Cause	Actual cause.	Not defined
Offset 1	With those parameters you have possibility to change value, which you will take from the data source. NewValue=(OldValue+Offset1)*Scale+Offset2	0
Offset 2		0
Scale 1		1
Scale 2		1
Start Value	Initial Value of logic calculation with the first operation.	0

4.14 Programmable logic *IsaGRAF*

Enilit RTU CMS provides an interface to the *IsaGRAF* programming tool for the programming of additional function of RTU. The following figure shows interface which enables to create inputs and outputs for the Programmable logic *IsaGRAF*.

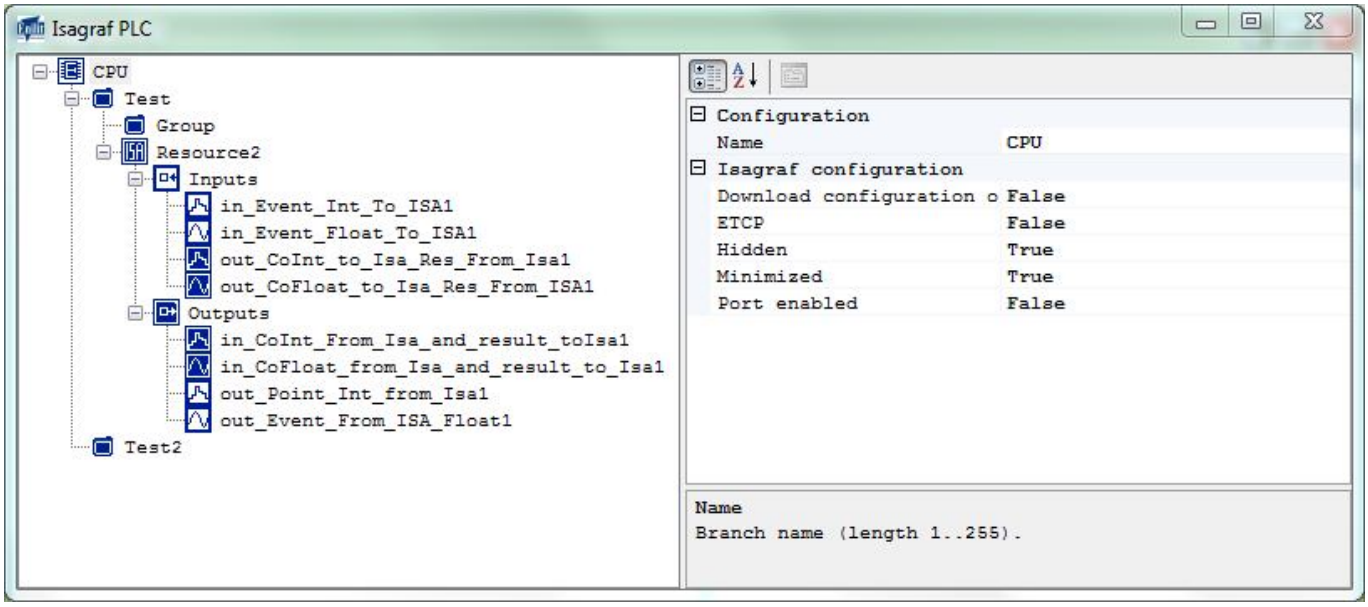


Figure 113. PLC Programming window

Field name	Description	Default value
Name	Branch name.	CPU
Download configuration on start	Download *IsaGRAF* solution to *IsaGRAF* on system start, in case Port enabled is Yes. Values: No, Yes	No

ETCP	Start TCP communication with remote PC for debugging and diagnosis. Values: No, Yes	No
Hidden	Start Isagraf modules hidden. Values: No, Yes	Yes
Minimized	Start Isagraf modules minimized. Values: No, Yes	Yes
Port enabled	Enables programmable logic IsaGRAF port. Values: No, Yes	No

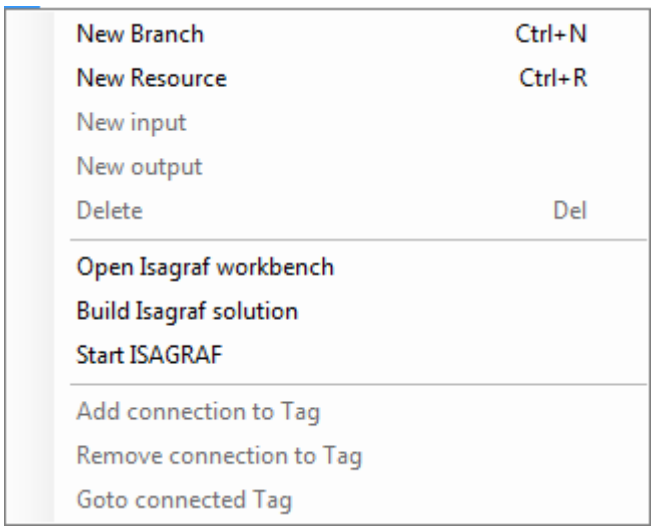


Figure 114. Popupmenu window

Field name	Description	Active
New Branch	Creates new branch.	Branches
New Resource	Creates new resource.	Branches
New input	Creates new input to the Isagraf.	Resources
New output	Creates new output from the Isagraf.	Resources
Delete	Enables to delete branch, resource, input or output.	Everywhere
Open Isagraf workbench	Open the integrated programmable logic environment *IsaGRAF* by selecting this menu item.	Everywhere
Build Isagraf solution	Build *IsaGRAF* program.	Everywhere
Start ISAGRAF	Starts *IsaGRAF* runtime.	Everywhere

Add connection to Tag	Enables to connect input or output to the Tag from the *Tag manager*.	Inputs, outputs
Remove connection to Tag	Enables to remove Tag connection.	Inputs, outputs
Go to connected Tag	Goes to the connected Tag in the *Tag manager*.	Inputs, outputs

IsaGRAF is an IEC 61131 open control software for automation. For more information on all operating functions of *IsaGRAF*, please refer to the Isagraf User Manual which can be called up via IsaGRAF software.

4.14.1 IsaGraf function blocks

Functional blocks designed specifically for Enilit RTU. With these functional blocks, you can manipulate events and commands.

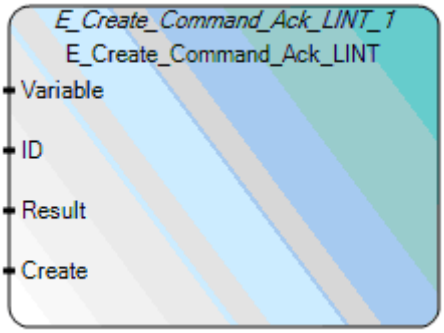


Figure 115. E_Create_Command_Ack_LINT

Creates integer command acknowledgement.

Field name	Description
Variable	Input of command. Data type: ENILIT_OUT_COACK_LINT
ID	Commands identification number. Data type: UDINT
Result	Command acknowledgement type: positive, negative, termination. Data type: BYTE
Create	Enable or disable acknowledgement. Data type: BOOL

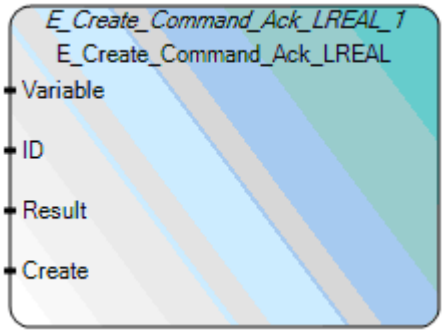


Figure 116. E_Create_Command_Ack_LREAL

Creates float command acknowledgement.

Field name	Description
Variable	Input of command. Data type: ENILIT_OUT_COACK_LREAL
ID	Commands identification number. Data type: UDINT
Result	Command acknowledgement type: positive, negative, termination. Data type: BYTE
Create	Enable or disable acknowledgement. Data type: BOOL

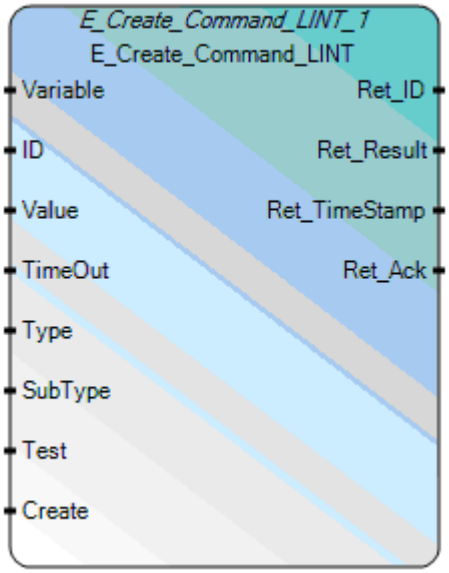


Figure 117. E_Create_Command_LINT

Creates integer command.

Field name	Description

Variable	Output of command to RTU. Data type: ENILIT_IN_COACK_LINT
ID	Commands identification number. Data type: UDINT
Value	Value of command. Data type: LINT
TimeOut	Wait for command acknowledgement. Data type: TIME
Type	Type of command: single, double. Data type: BYTE
SubType	Type of command: activation, deactivation. Data type: BYTE
Test	Command with test flag. Data type: BOOL
Create	Enable or disable acknowledgement. Data type: BOOL
Ret_ID	Identification number of command acknowledgement. Data type: UDINT
Ret_Result	Result of command acknowledgement. Data type: BYTE
Ret_TimeStamp	Timestamp of command acknowledgement. Data type: LINT
Ret_Ack	Acknowledgement positive or negative. Data type: BOOL

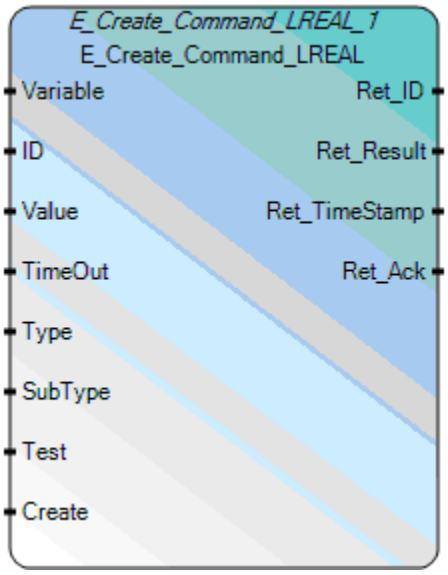


Figure 118. E_Create_Command_LREAL

Creates float command.

Field name	Description
Variable	Output of command to RTU. Data type: ENILIT_IN_COACK_LREAL
ID	Commands identification number. Data type: UDINT
Value	Value of command. Data type: LREAL
TimeOut	Wait for command acknowledgement. Data type: TIME
Type	Type of command. Data type: BYTE
SubType	Type of command: activation, deactivation. Data type: BYTE
Test	Command with test flag. Data type: BOOL
Create	Enable or disable acknowledgement. Data type: BOOL
Ret_ID	Identification number of command acknowledgement. Data type: UDINT
Ret_Result	Result of command acknowledgement. Data type: BYTE

Ret_TimeStamp	Timestamp of command acknowledgement. Data type: LINT
Ret_Ack	Acknowledgement positive or negative. Data type: BOOL

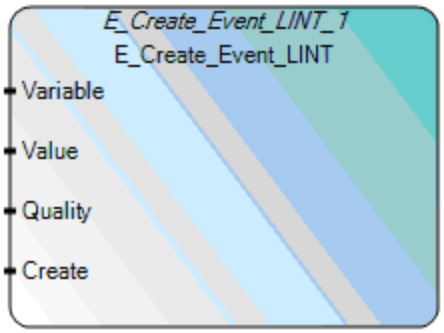


Figure 119. E_Create_Event_LINT

Creates integer event.

Field name	Description
Variable	Output of Event to RTU. Data type: ENILIT_OUT_EV_LINT
Value	Value of event. Data type: LINT
Quality	Quality of event. Data type: UINT
Create	Enable or disable event creation. Data type: BOOL

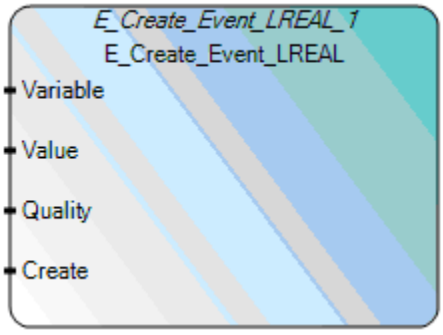


Figure 120. E_Create_Event_LREAL

Creates float event.

Field name	Description

Variable	Output of Event to RTU. Data type: ENILIT_OUT_EV_LREAL
Value	Value of event. Data type: LREAL
Quality	Quality of event. Data type: UINT
Create	Enable or disable event creation. Data type: BOOL

Figure 121. E_Get_TimeStamp

Gets timestamp of RTU.

Field name	Description
TimeStamp	TimeStamp of RTU. Data type: LINT

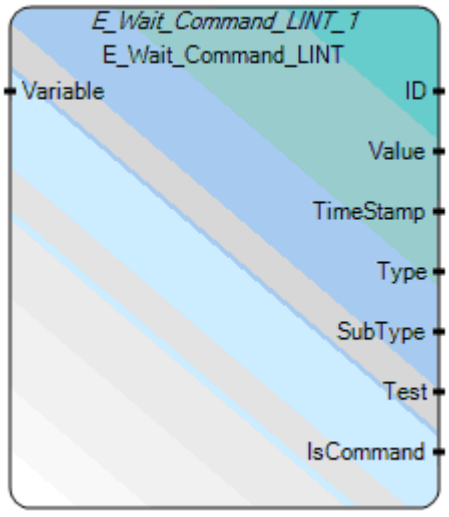


Figure 122. E_Wait_Command_LINT

Waits integer command.

Field name	Description
Variable	Input of command from RTU. Data type: ENILIT_OUT_COACK_LINT

ID	Commands identification number. Data type: UDINT
Value	Value of command. Data type: LINT
TimeStamp	TimeStamp of command. Data type: LINT
Type	Type of command. Data type: BYTE
SubType	Type of command: activation, deactivation. Data type: BYTE
Test	Command with test flag. Data type: BOOL
IsCommand	If Yes, then Command is active. Data type: BOOL

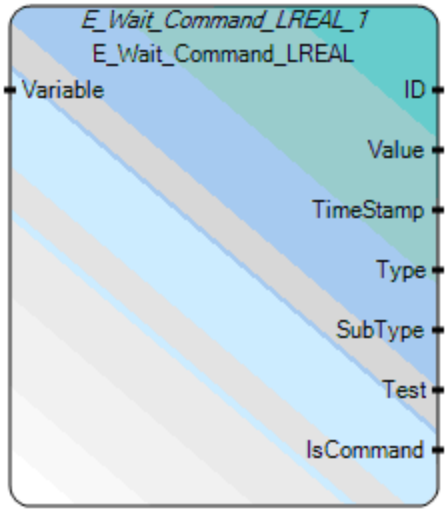


Figure 123. E_Wait_Command_LREAL

Waits integer command.

Field name	Description
Variable	Input of command from RTU. Data type: ENILIT_OUT_COACK_LREAL
ID	Commands identification number. Data type: UDINT
Value	Value of command. Data type: LREAL

TimeStamp	TimeStamp of command. Data type: LINT
Type	Type of command. Data type: BYTE
SubType	Type of command: activation, deactivation. Data type: BYTE
Test	Command with test flag. Data type: BOOL
IsCommand	If Yes, then Command is active. Data type: BOOL

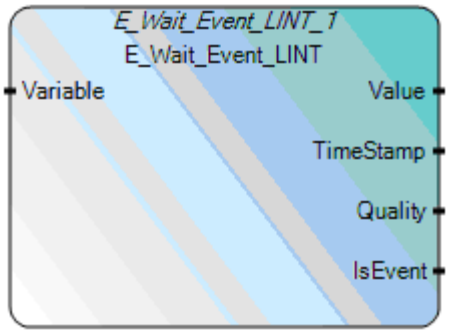


Figure 124. E_Wait_Event_LINT

Waits integer event.

Field name	Description
Variable	Input of event from RTU. Data type: ENILIT_IN_EV_LINT
Value	Value of event. Data type: LINT
TimeStamp	TimeStamp of event. Data type: LINT
Quality	Quality of event. Data type: UDINT
IsEvent	If Yes, then Event is active. Data type: BOOL

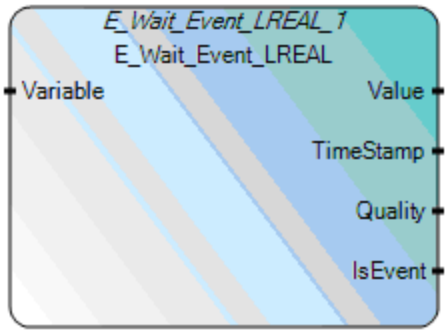


Figure 125. E_Wait_Event_LREAL

Waits float event.

Field name	Description
Variable	Input of event from RTU. Data type: ENILIT_IN_EV_LREAL
Value	Value of event. Data type: LREAL
TimeStamp	TimeStamp of event. Data type: LINT
Quality	Quality of event. Data type: UDINT
IsEvent	If Yes, then Event is active. Data type: BOOL

4.14.2 IsaGraf data types

Field name	Description
Command type	
E_CO_CANCEL	Deactivation
E_CO_EXECUTE	Execute
E_CO_SELECT	Select
E_CO_SELECT_EXECUTE	Select before Operate (SBO)
Commandacknowledgement	
E_COACK_BAD_COMMAND_TYPE	Bad command type
E_COACK_BAD_CONFIGURATION	Bad configuration
E_COACK_BAD_VALUE	Bad value
E_COACK_CANCEL_DONE	Deactivation confirmation
E_COACK_CANCEL_REJECTED	Deactivation rejected

E_COACK_COMMAND_ALREADY_IN_PROGRESS	Command already in progress
E_COACK_COMMAND_IN_PROGRESS	Command in progress
E_COACK_COMMAND_QUEUE_FULL	Command queue full
E_COACK_EXECUTE_DONE	Activation confirmation
E_COACK_EXECUTE_REJECTED	Activation rejected
E_COACK_INTELOCKED	Interlocked
E_COACK_LINK_DISABLED	Link disabled
E_COACK_LINKLAYER_ACK	Link layer acknowledgement
E_COACK_LINKLAYER_NACK	Link layer no acknowledgement
E_COACK_LINKLAYER_UNKNOWN	Link layer unknown acknowledgement
E_COACK_NO_COMMAND	No command
E_COACK_NO_LINK	No link
E_COACK_SELECT_DONE	Select confirmation
E_COACK_SELECT_REJECTED	Select rejected
E_COACK_TIME_OUT	Command time out
E_COACK_UNDEFINED_RESULT	Command execution undefined result
Command quality	
E_COSUB_LONG_PULSE	Long pulse
E_COSUB_NOT_DEFINED	Not defined
E_COSUB_PERSISTENT	Persistent
E_COSUB_SHORT_PULSE	Short pulse
Quality of event	
E_QUAL_BLOCKED	Blocked
E_QUAL_GOOD	Good
E_QUAL_INVALID	Invalid
E_QUAL_INVALIDTIME	Invalid time
E_QUAL_NOTINIT	Not initialized
E_QUAL_NOTTOPICAL	Not topical
E_QUAL_OVERFLOW	Overflow
E_QUAL_SUBSTITUTED	Substituted

4.15 Time management

4.15.1 SNTP client

In the time management window you can create new SNTP client to synchronize RTU date and time with external SNTP server.

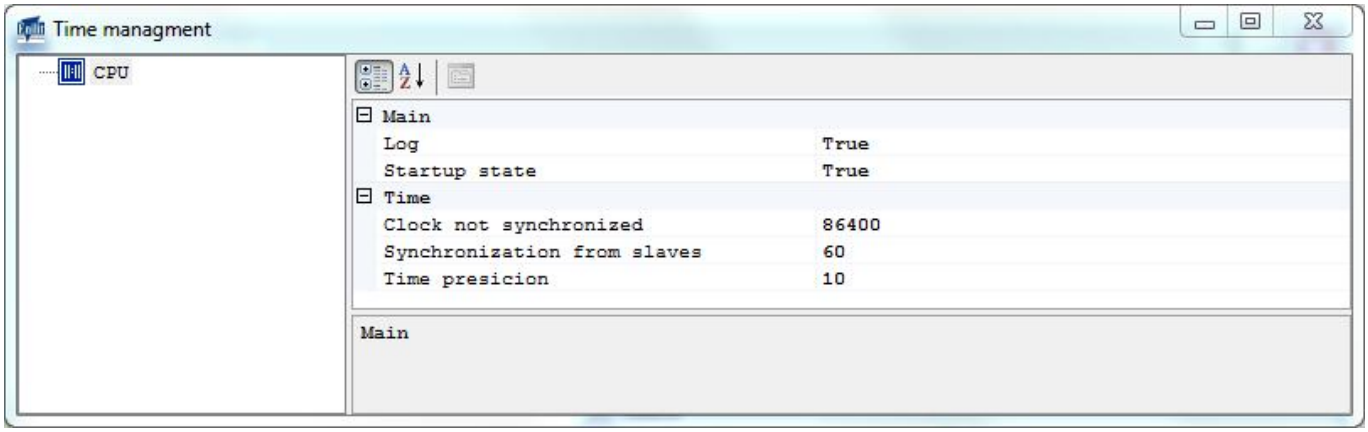


Figure 126. SNTP client window

Field name	Description	Default value
Log	Log clock synchronizations from slaves. Values: No, Yes	Yes
Startup state	Clock is synchronized on startup. Values: No, Yes	Yes
Clock not synchronized	If there was no clock synchronization for particular time, it will be considered that clock is not synchronized. Range of values: 1 … 86400 seconds	86400
Synchronization from slaves	After what time allow synchronization from slave communication protocols. 0 – means allow always synchronize, 1 – 86400 seconds – when there was no time synchronization from SNTP clients. Range of values: 1 … 86400 seconds	60
Time precision	Requested time precision in milliseconds. Clock will be synchronized only if time offset is larger than requested precision. Range of values: 1 … 60000 ms	10

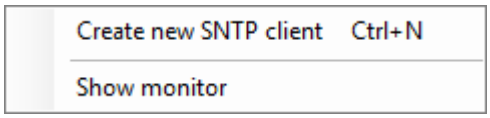


Figure 127. Create new SNTP client

If you have created new SNTP client, you will see following window with default parameters.
Other opportunity is to run *Show monitor* window. Monitoring window will show log data which you have enabled in the SNTP client configuration with the parameters *Log Data, Log IP, Log Raw.*

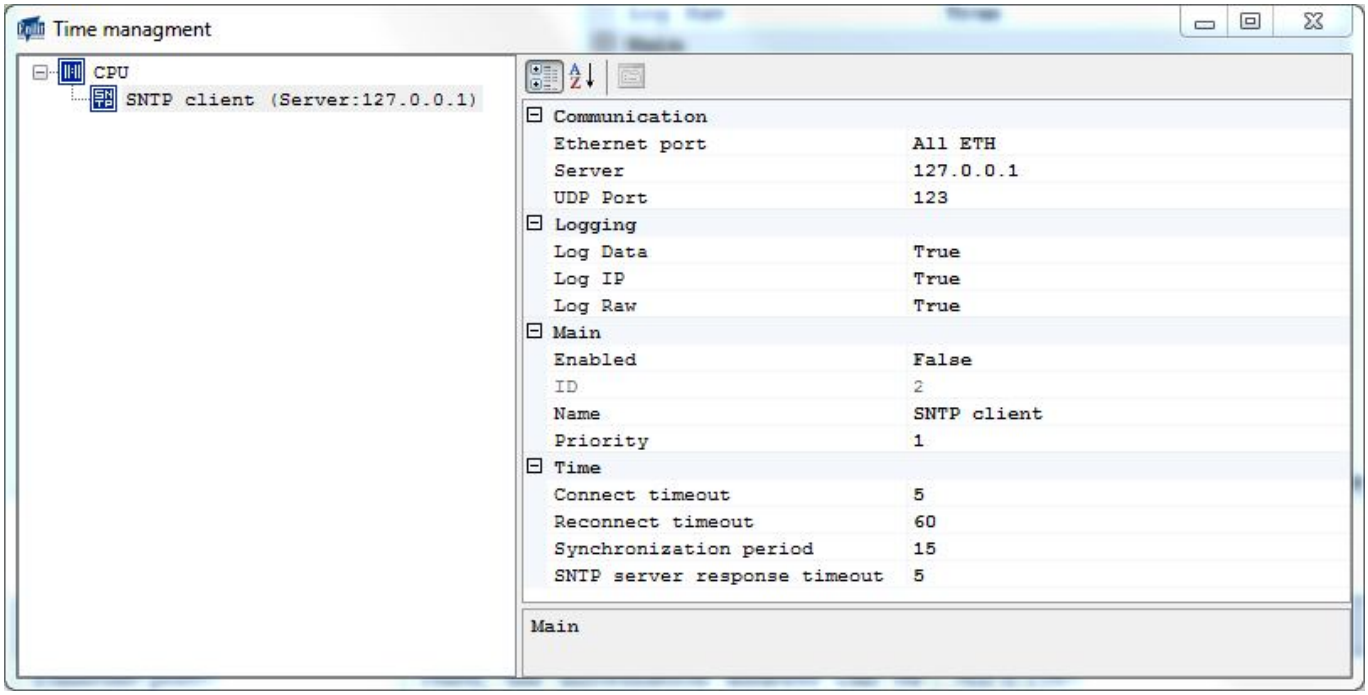


Figure 128. SNTP client window

Field name	Description	Default value
Ethernet port	Here, the information address can be specified. Range of values: ETH1 … ETH3	All ETH
Server	SNTP server IP address. Values: xxx.zzz.yyy.nnn	127.0.0.1
UDP Port	UDP port to connect with server. Range of values: 1 … 65535	123
Log Data	Enables to view data log. Values: No, Yes	Yes
Log IP	Enables to view IP log. Values: No, Yes	Yes
Log Raw	Enables to view raw log.	Yes

	Values: No, Yes	
Enabled	Enable or disable SNTP client. Values: No, Yes	No
ID	ID of SNTP client. Internal use. Range of values: 1 … 255	1
Name	Name of SNTP client. For example: “SNTP1”	SNTP client
Priority	If you will configure more than one SNTP server, you can rank servers in your order. Range of values: 1 … 255	1
Connect timeout	Connect timeout to SNTP server. Range of values: 1 … 60 seconds	5
Reconnect timeout	Reconnect timeout if connection before was failed. Range of values: 1 … 86400 seconds	60
Synchronization period	The time period to make synchronization. Range of values: 1 … 86400 seconds	15
SNTP server response timeout	Response timeout after request has been sent. Range of values: 1 … 86400 seconds	5

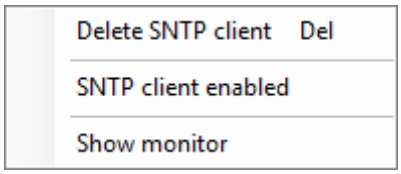


Figure 129. SNTP client popup window

With the Show monitor, you can open diagnostic tool for communication with SNTP server. The following window shows Time management monitor window.

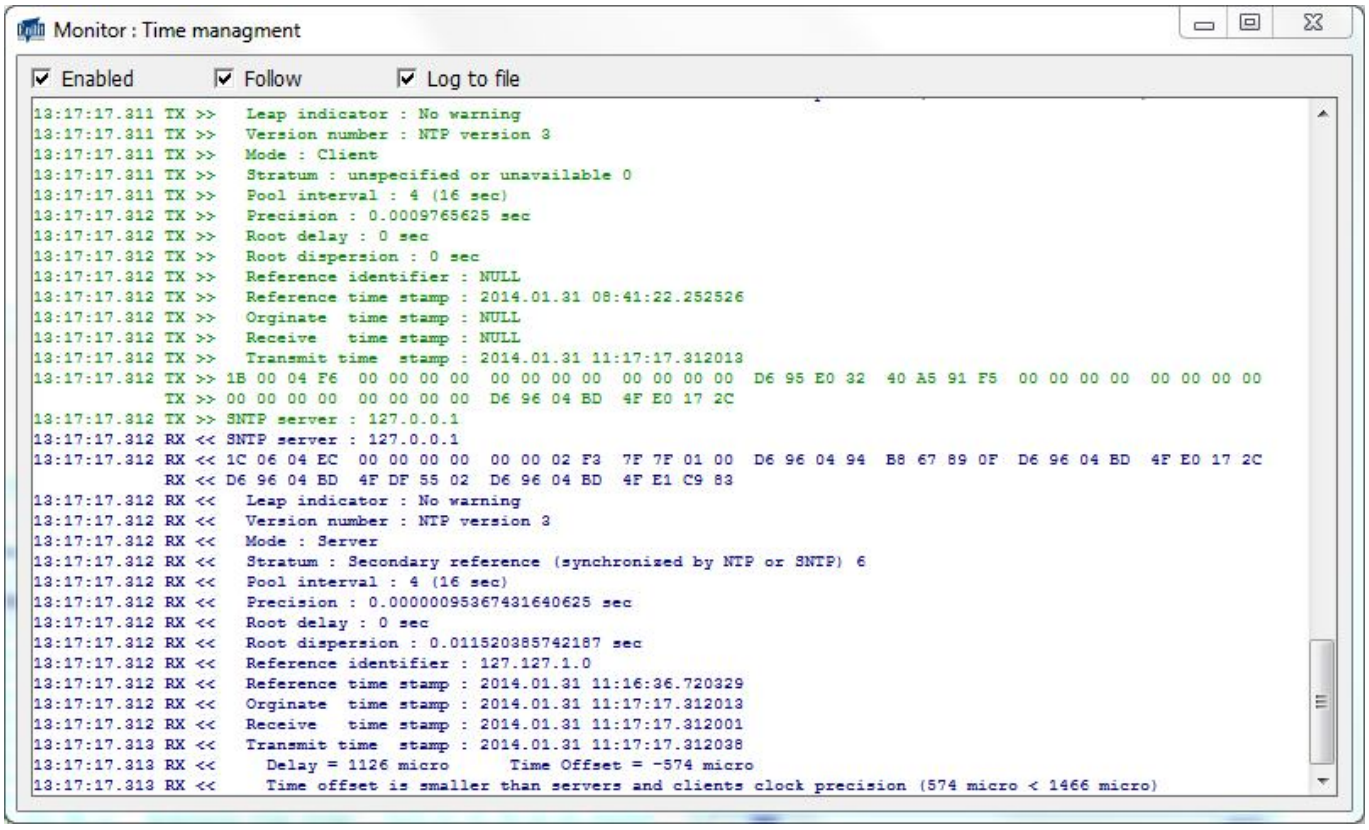

Monitor : Time managment
Enabled
Follow
Log to file
13:17:17.311 TX >> Leap indicator : No warning
13:17:17.311 TX >> Version number : NTP version 3
13:17:17.311 TX >> Mode : Client
13:17:17.311 TX >> Stratum : unspecified or unavailable 0
13:17:17.311 TX >> Pool interval : 4 (16 sec)
13:17:17.312 TX >> Precision : 0.0009765625 sec
13:17:17.312 TX >> Root delay : 0 sec
13:17:17.312 TX >> Root dispersion : 0 sec
13:17:17.312 TX >> Reference identifier : NULL
13:17:17.312 TX >> Reference time stamp : 2014.01.31 08:41:22.252526
13:17:17.312 TX >> Orginate time stamp : NULL
13:17:17.312 TX >> Receive time stamp : NULL
13:17:17.312 TX >> Transmit time stamp : 2014.01.31 11:17:17.312013
13:17:17.312 TX >> 1B 00 04 F6 00 00 00 00 00 00 00 00 00 00 00 00 D6 95 E0 32 40 A5 91 F5 00 00 00 00 00 00 00 00
TX >> 00 00 00 00 00 00 00 00 D6 96 04 BD 4F E0 17 2C
13:17:17.312 TX >> SNTP server : 127.0.0.1
13:17:17.312 RX << SNTP server : 127.0.0.1
13:17:17.312 RX << 1C 06 04 EC 00 00 00 00 00 00 02 F3 7F 7F 01 00 D6 96 04 94 B8 67 89 0F D6 96 04 BD 4F E0 17 2C
RX << D6 96 04 BD 4F DF 55 02 D6 96 04 BD 4F E1 C9 83
13:17:17.312 RX << Leap indicator : No warning
13:17:17.312 RX << Version number : NTP version 3
13:17:17.312 RX << Mode : Server
13:17:17.312 RX << Stratum : Secondary reference (synchronized by NTP or SNTP) 6
13:17:17.312 RX << Pool interval : 4 (16 sec)
13:17:17.312 RX << Precision : 0.00000095367431640625 sec
13:17:17.312 RX << Root delay : 0 sec
13:17:17.312 RX << Root dispersion : 0.011520385742187 sec
13:17:17.312 RX << Reference identifier : 127.127.1.0
13:17:17.312 RX << Reference time stamp : 2014.01.31 11:16:36.720329
13:17:17.312 RX << Orginate time stamp : 2014.01.31 11:17:17.312013
13:17:17.312 RX << Receive time stamp : 2014.01.31 11:17:17.312001
13:17:17.313 RX << Transmit time stamp : 2014.01.31 11:17:17.312038
13:17:17.313 RX << Delay = 1126 micro Time Offset = -574 micro
13:17:17.313 RX << Time offset is smaller than servers and clients clock precision (574 micro < 1466 micro)

Figure 130. Time management monitor window

4.16 Self-control and diagnosis

Enilit RTU CMS also provides diagnostic facilities which enable the user to view hardware status of RTU with its configuration, to analyze and view serials and TCP protocols data, to monitor current status of information objects, to test its and commands with test values, to view and keep saved system and events log.

4.16.1 Hardware monitoring

With the popup menu in *Enilit RTU Hardware* configuration window you can run *Enilit RTU Hardware state* monitoring.

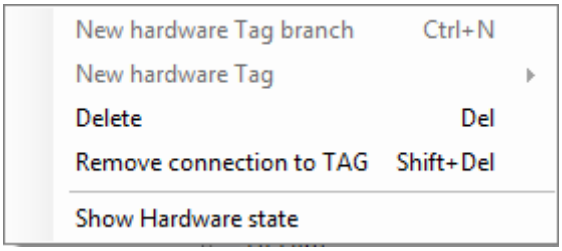


Figure 131. Hardware popup menu

When you click *Show Hardware state*, you will see following figure. With this window you can check if the hardware is well configured and working. In this hardware monitoring window you can see current states of all modules, output voltage of power supply, CPU temperature, Watchdog status, binary inputs and command outputs states, measurements current (mA) or voltage (V).

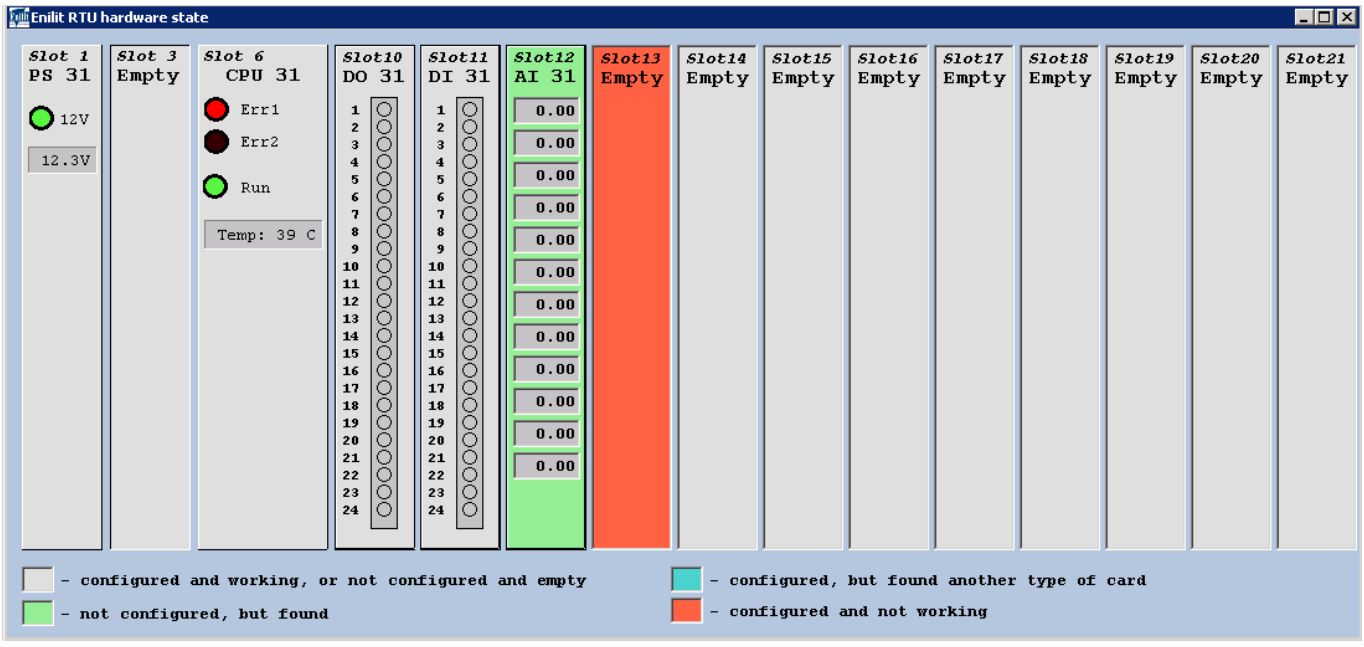


Figure 132. Hardware state window

- Configured and working, or not configured and empty.
- Not configured, but found.
- Configured, but found another type of module.
- Configured and not working.

4.16.1.1 Status signals, commands and measurements

Hardware status can be monitored via communication protocols. You can connect hardware status signals to tags with *Tag Manager*, you can control also hardware with commands from SCADA. Following figure shows Hardware status signals, commands and measurements window.

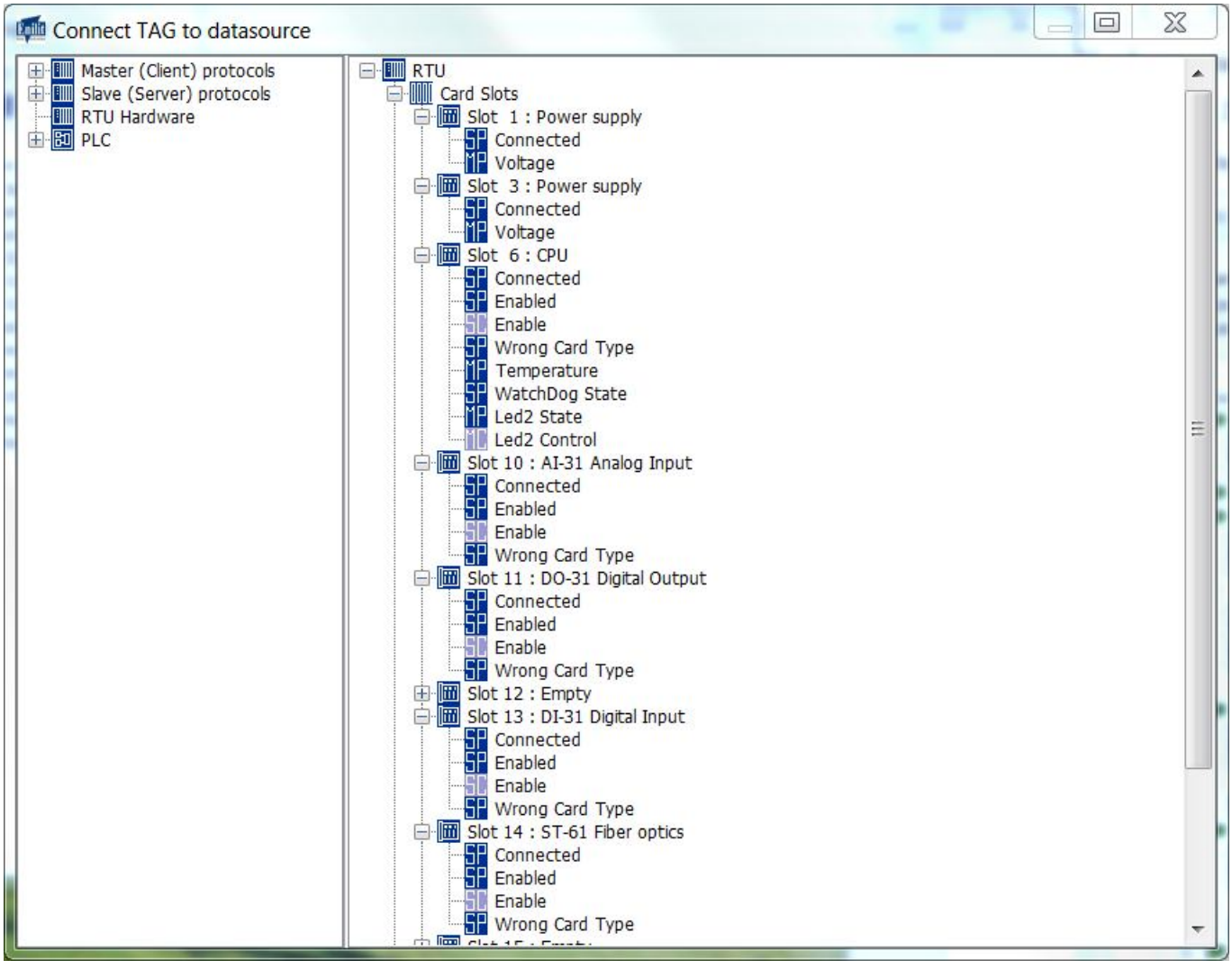


Figure 133. Hardware status signals, commands and measurements

Field name	Description	Card types
Connected	Central processor communicates with card. The card works without error. Type: Status item 0 – Normal	All

	1 – Fault	
Voltage	Power supply voltage measurement. Type: Status item	PS31
Enabled	Enabled or disabled card. Type: Status item 0 – Enabled 1 – Disabled	All
Enable	Enables or disables central processor communication with card. Type: Command item 0 – Disable command 1 – Enable command	All
Wrong Card Type	Central processor detects wrongs card type. Type: Status item 0 – Ok 1 – Fault	AI31, DI31, DO31, CPU
Temperature	Central processor voltage measurement. Type: Status item	CPU
Led2 State	Central processor Led2 state. Type: Status item 0 – Led2 off 1 – Led2 on	CPU
Led2 Control	Control of central processor Led2 state. Type: Command item 0 – Off 1 – On	CPU

4.16.2 Protocol monitoring

The following figure show communication port popup menu. With this popup menu you can run Protocol monitoring tool “Port monitor”.

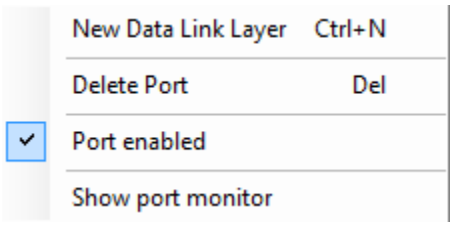


Figure 134. Communication port popup menu

Next figure shows this window in which you can view receiving and transmitting data through communication port. This window is for IEC 60870-5-103 protocol, but you can use it for all serial or TCP protocols even for SNTP.

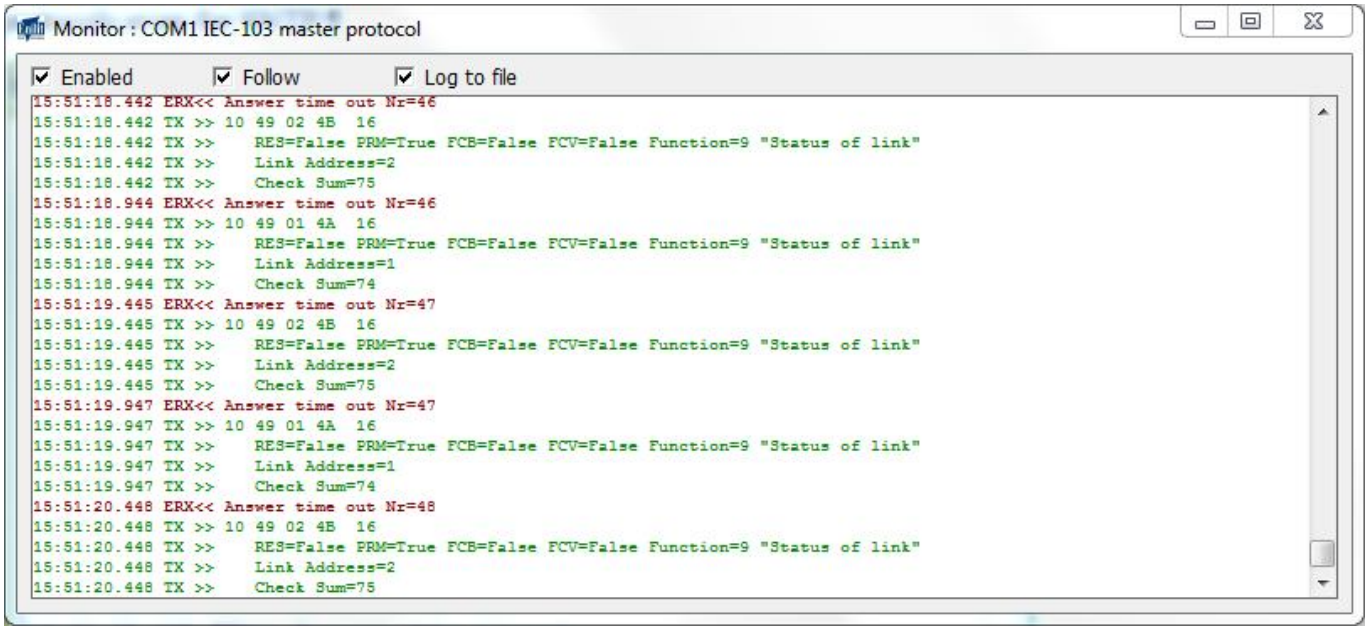


Figure 135. Standard master protocol monitor window

Field name	Description	Default value
Enabled	Enables to view communication data. Values: Checked, Unchecked	Unchecked
Follow	Enables to follow last communication data. Values: Checked, Unchecked	Unchecked
Log to file	Enables to log all data to log file. Values: Checked, Unchecked	Unchecked

Next figure shows that you can view communication data in monitoring direction either serial or TCP/IP between RTU and SCADA.

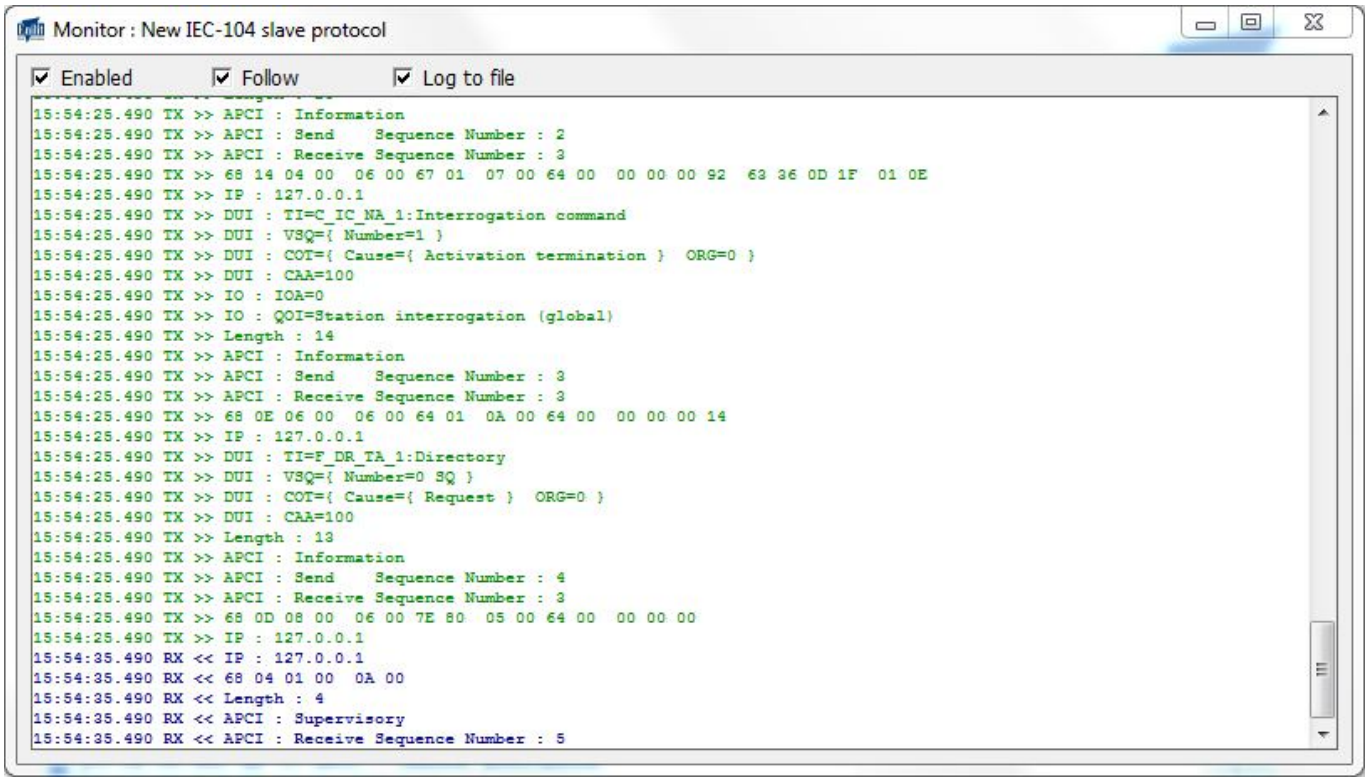

Monitor : New IEC-104 slave protocol
Enabled
Follow
Log to file
15:54:25.490 TX >> APCI : Information
15:54:25.490 TX >> APCI : Send Sequence Number : 2
15:54:25.490 TX >> APCI : Receive Sequence Number : 3
15:54:25.490 TX >> 68 14 04 00 06 00 67 01 07 00 64 00 00 00 00 92 63 36 0D 1F 01 0E
15:54:25.490 TX >> IP : 127.0.0.1
15:54:25.490 TX >> DUI : TI=C_IC_NA_1:Interrogation command
15:54:25.490 TX >> DUI : VSQ={ Number=1 }
15:54:25.490 TX >> DUI : COT={ Cause={ Activation termination } ORG=0 }
15:54:25.490 TX >> DUI : CAA=100
15:54:25.490 TX >> IO : IOA=0
15:54:25.490 TX >> IO : QOI=Station interrogation (global)
15:54:25.490 TX >> Length : 14
15:54:25.490 TX >> APCI : Information
15:54:25.490 TX >> APCI : Send Sequence Number : 3
15:54:25.490 TX >> APCI : Receive Sequence Number : 3
15:54:25.490 TX >> 68 0E 06 00 06 00 64 01 0A 00 64 00 00 00 00 14
15:54:25.490 TX >> IP : 127.0.0.1
15:54:25.490 TX >> DUI : TI=F_DR_TA_1:Directory
15:54:25.490 TX >> DUI : VSQ={ Number=0 SQ }
15:54:25.490 TX >> DUI : COT={ Cause={ Request } ORG=0 }
15:54:25.490 TX >> DUI : CAA=100
15:54:25.490 TX >> Length : 13
15:54:25.490 TX >> APCI : Information
15:54:25.490 TX >> APCI : Send Sequence Number : 4
15:54:25.490 TX >> APCI : Receive Sequence Number : 3
15:54:25.490 TX >> 68 0D 08 00 06 00 7E 80 05 00 64 00 00 00 00
15:54:25.490 TX >> IP : 127.0.0.1
15:54:35.490 RX << IP : 127.0.0.1
15:54:35.490 RX << 68 04 01 00 0A 00
15:54:35.490 RX << Length : 4
15:54:35.490 RX << APCI : Supervisory
15:54:35.490 RX << APCI : Receive Sequence Number : 5

Figure 136. Standard slave protocol window

Field name	Description	Default value
Enabled	Enables to view communication data. Values: Checked, Unchecked	Unchecked
Follow	Enables to follow last communication data. Values: Checked, Unchecked	Unchecked
Log to file	Enables to log all data to log file. Values: Checked, Unchecked	Unchecked

This communication port monitoring tool is very useful at substation commissioning stage. Commissioning engineer doesn't need any additional testing software, even worse hardware for port monitoring and so on.

4.16.2.1 Status signals, commands and measurements

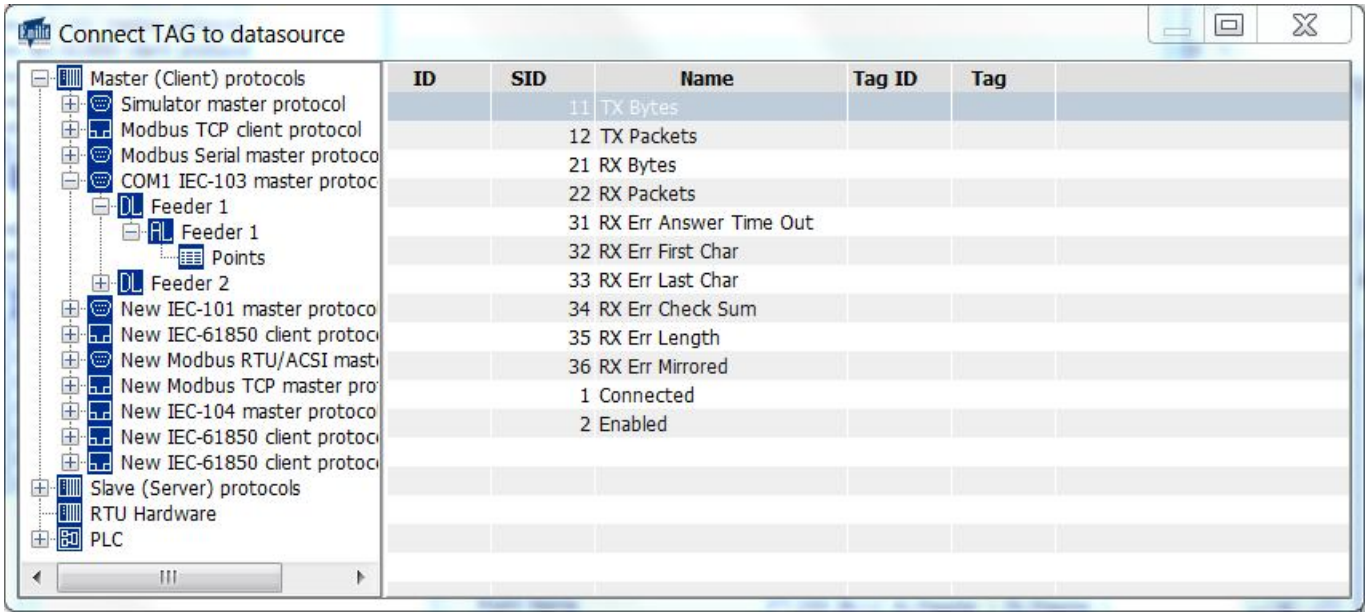


Figure 137. Standard system status items for master protocols

Field name	Description	Protocols
Connected	Connected to the slave device. Type: Status item 0 – Normal 1 – Communication error	All
Enabled	Enabled or disabled communication protocol. Type: Status item 0 – Enabled 1 – Disabled	All
TX Bytes	Count of protocol transmitted bytes. Type: Float	All
TX Packets	Count of protocol transmitted packets. Type: Float	All
RX Bytes	Count of protocol received bytes. Type: Float	All
RX Packets	Count of protocol received packets. Type: Float	All
RX Err Answer Timeout	Type: Float	IEC-101, 103
RX Err First Char	Type: Float	IEC-101, 103

RX Err Last Char	Type: Float	IEC-101, 103
RX Err Check Sum	Type: Float	IEC-101, 103
RX Err Length	Type: Float	IEC-101, 103
RX Err Mirrored	Type: Float	IEC-101, 103

4.16.3 System log

When you start *Enilit RTU CMS* the first window is *System log* window. This window is also written to the file. The location of logs is described in the RTU description file.

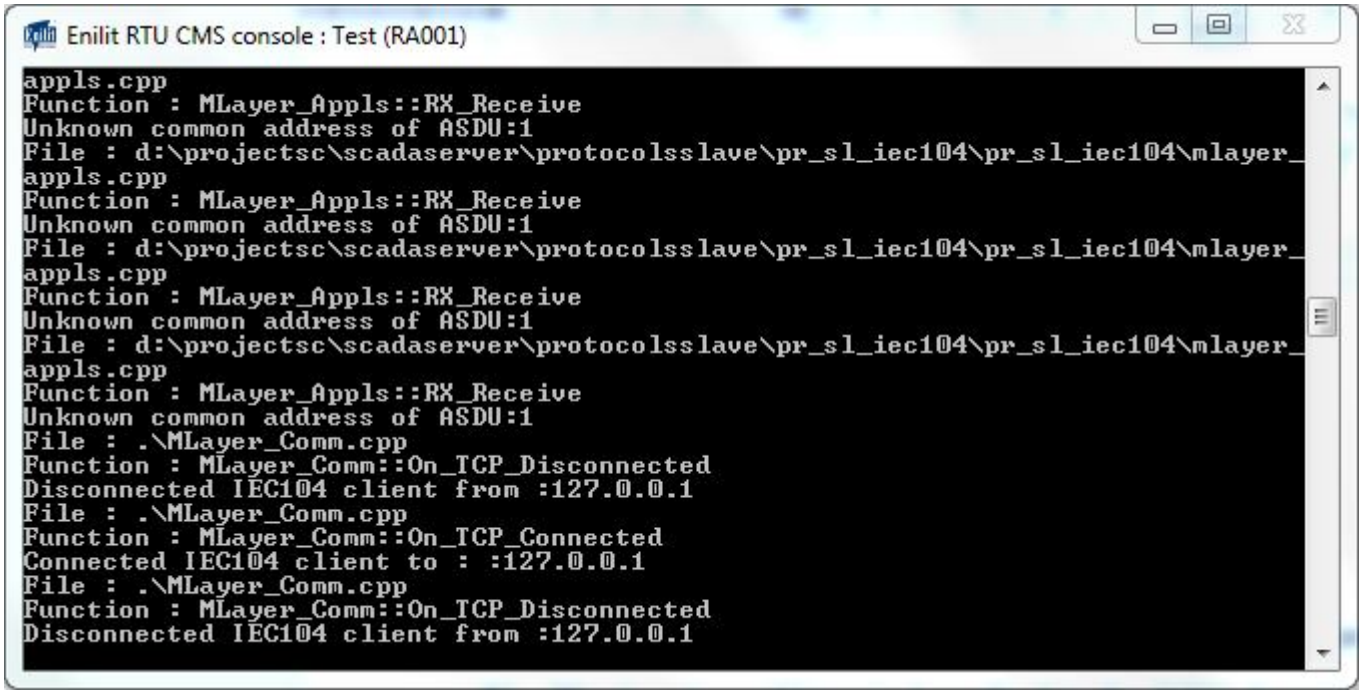


Figure 138. System log window

4.16.4 Events log

In the *Tag Manager* tool you can configure *Events log*. This window is also written to the file. By default *Events log* files are stored in the RTU configuration directory *Logs*. The location of logs is described in the RTU description file.

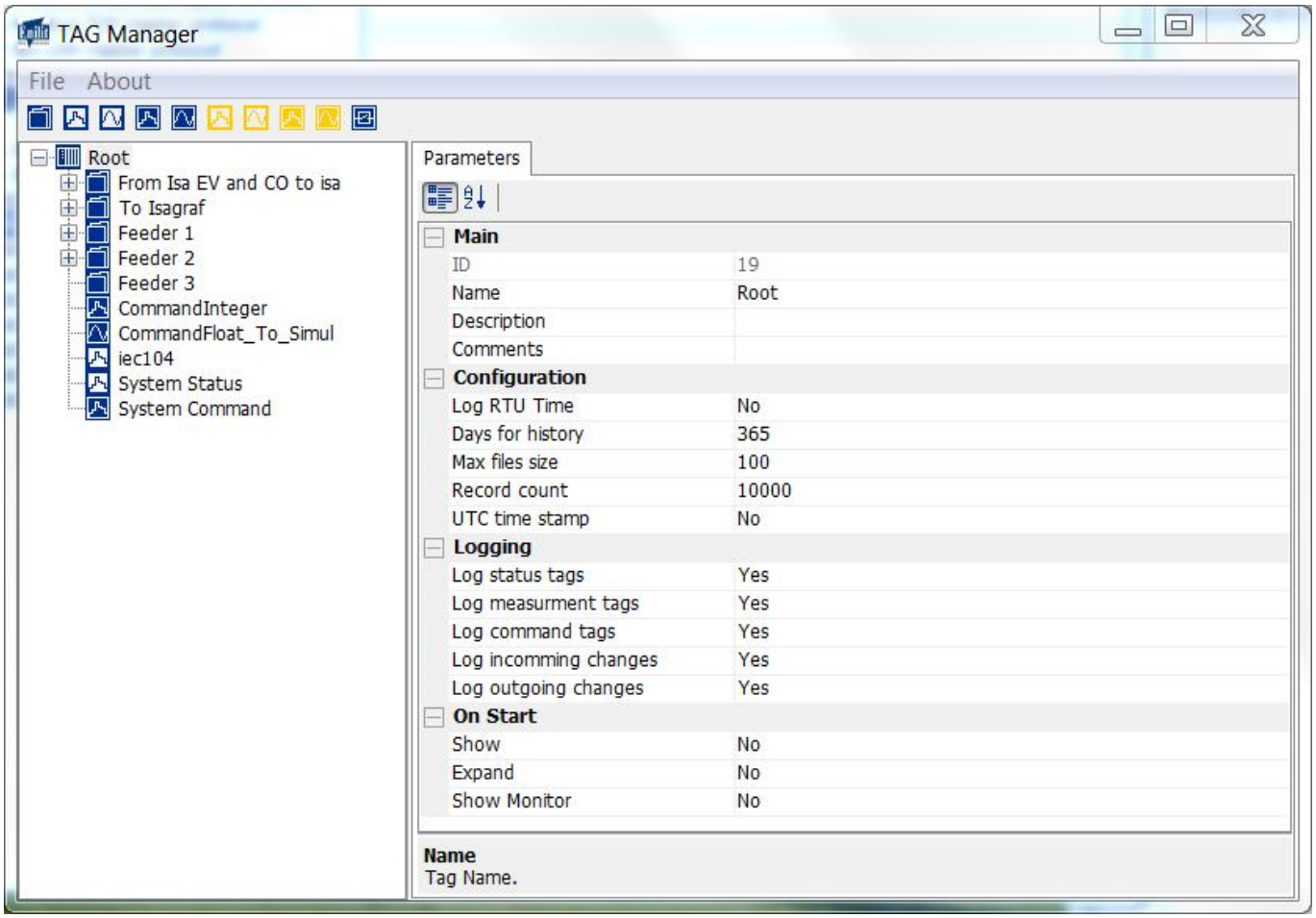


Figure 139. Main *Tag manager* window

Field name	Description	Default value
Log RTU Time	Additional column will be added to history files, which shows event received time in TAG Manager. Values: No, Yes	No
Days for history	How many days to keep events in *Events list*. Range of values: 10 … 1000 days	365
Max file size	Maximum size of all *Events list* files Range of values: 10 … 1000 Mb	100
Record count	Record count in one *Events list* file Range of values: 1000 … 100000	10000
UTC time stamp	Time stamp of events to be saved in *Events list*. Values: No, Yes	No
Log status tags	Log status changes to Events list files. Values: No, Yes	Yes

Log measurements tags	Log measurements changes to Events list files. Values: No, Yes	Yes
Log command tags	Log commands changes to *Events list* files. Values: No, Yes	Yes
Log incoming changes	Log incoming changes to *Events list* files. Values: No, Yes	Yes
Log outgoing changes	Log outgoing changes to *Events list* files. Values: No, Yes	Yes

4.17 Redundancy

4.17.1 Redundancy support

Safety, reliability, high availability, and functionality are vital components of every control system in today's world. Enilit system utilize dual RTU and power supplies redundancy.
The system provide for automatic monitoring of primary and hot standby RTU. Failures are detected automatically and trigger a switchover from the primary RTU to hot standby RTU. All communication channels are automatically switched to primary RTU. The switchover and data transfer is fast and bumbles, thereby ensuring that there is no interruption in process control.

4.17.2 Redundancy types

4.17.2.1 Cold-Standby

A method of redundancy in which the secondary RTU system is only called upon when the primary system fails. The system on cold standby receives scheduled data backups, but less frequently than a warm standby. Cold standby systems are used for non-critical applications or in cases where data is changed infrequently.

4.17.2.2 Warm-Standby

A method of redundancy in which the secondary RTU system runs in the background of the primary system. Data is mirrored to the secondary RTU at regular intervals, which means that there are times when both servers do not contain the exact same data.

4.17.2.3 Hot-Standby

A method of redundancy in which the primary RTU and secondary RTU systems run simultaneously. The data is mirrored to the secondary RTU in real time so that both systems contain identical information. This method lets fast switchover from active to standby RTU, because both of RTUs have the same data. Hot-standby redundancy is default used in Enilit RTU, but on customer request it can be change to Cold-Standby or Warm-Standby. Further description is mostly about this type of redundancy.

4.17.3 Connection diagram

To support redundancy, RTU's must be connected one with other using LAN or RS-485 or RS-232 interfaces. These communication paths are used to exchange real time data between active and standby RTU. It is possible to use maximum of 4 redundant connections between RTU's.

- RS-485 or RS-232 (COM1-COM12)
- RS-485 or RS-232 (COM1-COM12)

- LAN (ETH1-ETH7)
- LAN (ETH1-ETH7)

Figure 140. Example of connections between redundant RTU's

Only one of these connections is used for data exchange. Others are used for health monitoring of active RTU. In case of broken data communication path, other active connection will be selected. Ethernet connections are much faster, so first one of these connections will be used for data exchange. In case when there are no Ethernet connections, serial will be selected. Even if serial selected, by default 115,200 kbs speed it is possible to transfer about 500 events per second between RTU's. On request, speed can be increased for serial connections.

4.17.4 Enilit RTU redundancy principles

Enilit redundancy system consists of two RTU's. One of it is called Active and another Standby. At any time there can be only one Active RTU. The Active RTU is responsible:

- data acquisition from slave and server devices
- command transmission to slave and server devices
- PLC calculation
- process information transmission to upper communication levels
- process information transmission to Standby RTU

The Standby RTU is responsible:

- data acquisition from Active RTU
- process information transmission to upper communication levels
- monitoring of connections to Active RTU

If Standby RTU is healthy and running, it receives all process information from Active RTU so it can transmit all necessary data to upper communication levels. No matter how many redundant connections are configured between Active and Standby RTU's, if there at least one connection healthy, Standby RTU knows that Active RTU is running correctly. If there are no connections between Standby and Active RTU, Standby RTU changes its state to Active. The switchover can be also executed manually. In this case the

Standby RTU will change to Active RTU, and Active RTU will change to Standby RTU. Because Standby RTU always acquires process information from Active RTU, the switchover is fast and bumbles.

4.17.5 Monitored fault locations

This section describes what can be monitored and used for automatic switchover form standby to active RTU. Most of those monitored information is user selectable from system self-control and diagnosis Tags (See description about 4.13Self-control and diagnosis). Monitored information:

- Communication paths between Active and Standby RTU‘s (this is done by default and is not user selectable).
- RS-485, RS-232 port hardware errors and state.
- Ethernet port hardware errors and state.
- Cards hardware errors and state.
- Inner voltages and temperatures.
- Main CPU state.
- Power supply state.
- Main Watchdog relay on CPU card (Digital Input type card will be needed on both of RTU‘s to check relay state).
- Other specifics can be added on customer request.

All this monitored information can be used for configuration of automatic switchovers, according to user needs.

4.17.6 Communication channel configuration

4.17.6.1 Redundancy Connection LAN1 parameters

Field name	Description	Default value
Ethernet port	Choose RTU Ethernet port. Values: ETH1, ETH2...ETHn	Empty
IP Address	IP Address of redundant RTU For example: 10.2.2.1	127.0.0.1
IP Port	TCP/IP connection port.	5404
Timeout	Communication timeout. In case if this is last connection between RTU’s and it is timed out, then switchover from Standby RTU to Active happens.	1000 milliseconds

4.17.6.2 Redundancy Connection LAN2 parameters

Field name	Description	Default value
Ethernet port	Choose RTU Ethernet port. Values: ETH1, ETH2...ETHn	Empty
IP Address	IP Address of redundant RTU For example: 10.2.2.1	127.0.0.1
IP Port	TCP/IP connection port.	5404
Timeout	Communication timeout. In case if this is last connection between RTU's and it is timed out, then switchover from Standby RTU to Active happens.	1000 milliseconds

4.17.6.3 Redundancy Connection RS-485 1 parameters

Field name	Description	Default value
Com port	Choose RTU COM port. Values: COM1 COM2 ... COMn	Empty
Timeout	Communication timeout. In case if this is last connection between RTU's and it is timed out, then switchover from Standby RTU to Active happens.	1000 milliseconds

4.17.6.4 Redundancy Connection RS-485 2 parameters

Field name	Description	Default value
Com port	Choose RTU COM port. Values: COM1 COM2 ... COMn	Empty

Timeout	Communication timeout. In case if this is last connection between RTU's and it is timed out, then switchover from Standby RTU to Active happens.	1000 milliseconds

4.17.7 Status signals, commands and measurements

4.17.7.1 Standard system status items for redundant connections

Field name	Description	Redundant connections
Connected	Connected to the redundant RTU. Type: Status item 1 – Normal 0 – Communication error	All
Enabled	Enabled or disabled redundant connection. Type: Status item 1 – Enabled 0 – Disabled	All
Transmitted Bytes	Protocol transmitted bytes. Type: Measurement	All
Transmitted Packets	Protocol transmitted packets. Type: Measurement	All
Received Bytes	Protocol received bytes. Type: Measurement	All
Received Packets	Protocol received packets. Type: Measurement	All

4.17.7.2 Standard system status items for redundancy

Field name	Description	
State	RTU redundancy state. Type: Status item 0 – Standby 1 – Active	
Switchover	Switchovers current RTU to new state. Type: Command item	

	0 – To Standby 1 – To Active	
Connections	Current active redundancy connections Type: Measurement	

4.18 Cyber security capabilities

4.18.1 Introduction

Cyber data security is a vital element of system's reliability. It decreases cyber-crimes and increases the security and availability of the system communication network.

System where RTU's are used (power, water, oil supply systems) usually are critical infrastructure. Security threats generally consist of attacks against assets. These assets may not only be physical facilities, but also cyber information, databases and software applications. Targets such as IEDs, SCADA (Supervisory Control and Data Acquisition) systems, EMS (Energy Management Systems), databases, applications and web services can be attacked. Even if the network is completely isolated and no remote equipment is connected, attacks may even be initiated by operational personnel who lack special training and awareness.

Cyber data security is a vital element of system's reliability. It decreases cyber-crimes and increases the security and availability of the system communication network. In order to prevent from such attacks in Enilit RTU is made data cyber security capabilities according standard IEEE 1686-2007, IEEE Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities, February 2008.

IEEE 1686-2007 is a security standard for IEDs. It establishes requirements for IED security in accordance with NERC CIP. This standard defines the functions and features to be provided in substation IEDs to accommodate critical infrastructure protection programs.

The main Enilit RTU Cyber security Capabilities are given in the chapters below, if some extra security functions is required they could be added on client request.

4.18.2 Electronic access control

All electronic access to the Enilit RTU locally through a communication/diagnostic port with a test set or personal computer, or remotely through a communications media is password protected. It is not possible to gain access to the device without a proper password that has been generated by the user.

4.18.2.1 Password defeat mechanisms

The Enilit RTU has no means whereby the user-created password control can be defeated or circumvented. This includes such mechanisms and techniques such as:

- Vendor-embedded master password;
- Chip-embedded diagnostic routines made accessible by hardware or software failures;
- Hardware bypass capabilities such as jumpers and switch settings.

The UAB Enilit guaranties that no such mechanisms exist which would allow circumvention of the user-created password control.

4.18.2.2 Number of individual password supported

The thousands of unique user-access passwords could be created.

4.18.2.3 Password construction

User-created passwords follow a set of rules which must be adhered to in the creation of each password. A minimum of 8 characters is used. The password characters should contain the following:

- At least one uppercase and one lower case letter
- At least one number
- At least one non-alphanumeric character (e.g., @%&*)

Any attempt to create a password which violates these rules is captured at the time of attempted creation and the user will be notified and prompted to choose another password which conforms to the rules.
For more information about users passwords see paragraph 4.5.3 of this document.

4.18.2.4 Authorization levels by password

The Enilit RTU supports the ability to assign authorization to utilize Enilit RTU functions and features based on individual user-created passwords. At a minimum, the following functions and features shall have this assignability available:

- View Data – the ability to view operational data (voltage, current, power, energy, status, alarms, et. al);
- View Configuration Settings – the ability to view configuration settings of the Enilit RTU such as scaling, communications addressing, programmable logic routines;
- Force Values – the ability to manually override real data with manually inputted data and/or the ability to cause a control output operation to occur;
- Configuration Change – the ability to download and upload configuration files to the unit and/or effect changes to the existing configuration;
- Password Management – The ability to create, delete or modify passwords and/or password authorization levels;
- Audit Log – The ability to view and download the audit log.

For more information about User groups (Roles of Users) see paragraph 4.5.2 of this document.

4.18.2.5 Password display

It is not possible to cause Enilit RTU access passwords displayed through any means, including configuration software connection and terminal access.

4.18.2.6 Access timeout

The Enilit RTU has a timeout feature which revokes all access levels granted through password entry after a period from user inactivity. Inactivity shall be defined as the absence of input keystroke activity on a computer connected to the Enilit RTU port. The period of time before the timeout feature activates is settable between 1 and 60 minutes by the user in the configuration of the Enilit RTU.

4.18.3 Audit trail

The Enilit RTU records in events in the order in which they occur. This audit trail is in the form of a file which can be viewed on a computer attached to the Enilit RTU diagnostic/maintenance port.

4.18.3.1 Storage capability

The audit trail facility has the capability to store more than 10 000 events before the circular buffer begins to overwrite the oldest event with the newest event. There is no capability to erase or modify the audit trail. It is not possible to remove the storage media of the audit trail without permanently damaging the Enilit RTU beyond the capability of field repair.

4.18.3.2 Storage record

For each audit trail event, the following information is recorded:

- Event Record Number;
- Time & Date – Time and date of the event will be recorded in a yy/mm/dd/hh/mm format;
- User Identification – The user ID logged into to the Enilit RTU at the time of the event;
- Event Type.

4.18.3.3 Audit trail event Types

The following events shall cause an entry into the Audit Trail record

- Log In – Successful log in;
- Manual Log Out – User Initiated;
- Timed Log Out – Log out of User after defined period of inactivity elapses;
- Value forcing – Operator action that overrides real data with manual entry and/or causes a control operation;
- Configuration Access – Download of the configuration file;
- Configuration Change – Upload to the Enilit RTU of a new configuration file or keystroke entry of new configuration parameter;
- Password Creation – Creation of new password or modification of password level of authorization;

- Password Revocation – Revocation of a password;
- Audit Log Access – User access of audit log for viewing or file download;
- Time/Date Change – User request to change time and date;

Keywords	Date and Time	Source	Event ID	Task Category
Audit Success	2013.12.04 08:24:56	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:56	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:55	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:55	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:54	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:54	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:51	Microsoft Windows securi...	4738	User Account Management
Audit Success	2013.12.04 08:24:51	Microsoft Windows securi...	4725	User Account Management
Audit Success	2013.12.04 08:24:47	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:47	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:46	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:46	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:47	Eventlog	1102	Log clear

Figure 141. Audit Trial log

Policy	Security Setting
Audit account logon events	Success, Failure
Audit account management	Success, Failure
Audit directory service access	Success, Failure
Audit logon events	Success, Failure
Audit object access	Success, Failure
Audit policy change	Success, Failure
Audit privilege use	Success, Failure
Audit process tracking	Success, Failure
Audit system events	Success, Failure

Figure 142. Settings of Audit Trial.

Enilit RTU CMS independently from Windows Operation System stores some of those events in System Log file. This is important if it's needed to send Security events through IEC or DNP communication protocols to SCADA.

4.18.4 Supervisory monitoring and control

In addition to the Audit Trail capability, the Enilit RTU monitors security-related activity and make the information available through a real-time communication protocol for transmission to a supervisory system.
If serial communications are used for the configuration of the Enilit RTU and the supervisory communications port, separate serial communications ports is provided for configuration and supervisory monitoring.
Configuration port activity not interfere nor disable the supervisory monitoring port with the exception of a configuration. Information to be monitored and transmitted falls into two groups: Event and Alarm.

4.18.4.1 Events

Events are defined as authorized activities which can be expected to occur in the routine use and maintenance of the Enilit RTU. All events can be monitored and transmitted to the supervisory system.
Event points have momentary change detect capability so that the occurrence of an event will be reported on the next scan of the Enilit RTU by the supervisory system. The Enilit RTU reports each occurrence as an individual event.

4.18.4.2 Alarms

Alarms are defined as activities which may indicate unauthorized activity. The following will cause an Alarm occurrence:

- Unsuccessful login attempt – defined as configured incorrect password entries insuccession;
- Reboot;
- Attempted use of unauthorized configuration software;

4.18.5 Configuration software

The Enilit RTU has an authentic configuration software. It could be configured with any software except supported by UAB Enilit.
ENILIT RTU configuration software has the ability to assign features to specific users. At a minimum, the following functions and features could be assignable on an individual user basis:

- View Configuration Data – in this mode, a user can only view configuration data. No changes to the configuration can be made.
- Change Configuration Data – in this mode, the user can change and save configuration data to be uploaded to the Enilit RTU at a later point in time.
- Full Access – in this mode, all functions, including password changes and user assignment levels can be made.

The configuration software is password controlled so that the software cannot be accessed without the proper password.

All communications ports other on the Enilit RTU have the capability to be enabled or disabled through configuration of the Enilit RTU. When disabled through configuration, no communications will be possible through that port.

Abbreviations

ADU	Application Data Unit
APDU	Application Protocol Data Unit
CMS	Configuration and Management Software
CPU	Central processing unit
CS	Clock synchronization
DPC	Double point command
DPS	Double point signal
GI	General interrogation
ICD	IED Capability Description
IED	Intelligent Electronic Device
MV	Measurement value
PLC	Programmable logic controller
RTU	Remote terminal unit
SCADA	Supervisory control and data acquisition
SCL	Substation Configuration Language
SNTP	Simple Network Time Protocol
SPC	Single point command
SPS	Single point signal
TCP	Transmission Control Protocol
UTC	Coordinated Universal Time

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